OCR
Oxford Cambridge and RSA

GCE

Biology A

Unit **H420/02:** Biological diversity

Advanced GCE

Mark Scheme for June 2018

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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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Annotations

In mark scheme:

Annotation	Meaning
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

In RM Assessor:

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

Question			Answer	Marks	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**	
2			C ✓	**1**	
3			A ✓	**1**	
4			B ✓	**1**	
5			C ✓	**1**	
6			A ✓	**1**	
7			B ✓	**1**	
8			B ✓	**1**	
9			A ✓	**1**	
10			D ✓	**1**	
11			B ✓	**1**	
12			C ✓	**1**	
13			A ✓	**1**	
14			C ✓	**1**	
15			B ✓	**1**	
			Total	**15**	

Question			Answer		Marks	Guidance
16	(a)	(i)	metaphase ✓		1	**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**	**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 DO NOT CREDIT** arrows
			3	ruled label lines (touching correct feature) ✓		**4 ALLOW** chromatids
			4	chromosome(s) **and** cytoplasm labelled ✓		**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	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	*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	*Electron microscope = 0 marks* **ALLOW** not black & white **IGNORE** stain / dye **ALLOW** whole cell visible **IGNORE** refs to resolution unqualified

Question			Answer	Marks	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**	**1 ALLOW** cloning **2 IGNORE** embryonic development **3 CREDIT** e.g. clonal expansion **4 IGNORE** gamete production unqualified
			Total	**11**	

Question			Answer	Marks	Guidance
17	(a)	(i)	**1** penguin species have overlapping / AW , <u>niches</u> ✓ **2** <u>competitive exclusion</u> ✓ **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 / <u>competition</u> from , gentoo ✓	**3 max**	**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**	*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 , <u>per year / y^{-1}</u>

Question			Answer	Marks	Guidance
	(b)	(i)	*supports because…* 1 Adélie / ice-reliant / AW , penguin (population) decreased **OR** gentoo / chinstrap / non-ice-reliant , penguin (population) increased ✓ figs that support either point given above ✓ 2 *does not support because…* *idea that* changes could be explained by (chance) arrival of , gentoo / chinstrap (and subsequent competition) ✓ 3 change in another described factor could explain changes (in a single species) ✓ 4 correlation does not mean causation ✓ 5	**3 max**	*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	Guidance
	(b)	(ii)			2 max	
			1	reduction in extent of ice ✓		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><th colspan="3">Question</th><th colspan="4">Guidance</th></tr>
<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):
○ award the higher mark where the Communication Statement has been met.
○ 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	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**	**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**	*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) <u>colonies</u> ✓ **3** *idea that* anomalies will have smaller effect ✓ **4** more representative / larger , sample ✓ **5** (fewer serial dilutions) decreases chance of <u>error</u> ✓ **6** F (is appropriate) because , colonies / AW , are countable ✓	**3 max**	**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

Question					
	(c)	(i)*			
			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.*	**6**	

Question			Answer	Marks	Guidance
		(ii)	control ✓ *idea of* checking for contamination ✓	2	**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	**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	**IGNORE** identify / ignore / exclude **ALLOW** reliability **IGNORE** valid / accurate **ALLOW** any named statistical test
			Total	18	

Question			Answer	Marks	Guidance
20	(a)	(i)	4.7 ✓✓	2	*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	**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	**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	**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	**CREDIT** number of polymorphic genes
		(ii)	(many) alleles lost (when population dropped) ✓ **ora** (modern population) descended from few survivors / AW ✓	2	**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	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	**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	*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	**3 ALLOW** pre-existing genetic variation **4 IGNORE** best adapted / fittest

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

Question			Answer	Marks	Guidance
21	(a)		working out the sequence / AW , of nucleotides / bases ✓	1	**IGNORE** base pairs
	(b)		100 000 000 / 100 million / 1.0 x10^8 / 1 x10^8 ✓✓	2	**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	 **ALLOW** swapping radioactive tags for fluorescent tags

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</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>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>IGNORE base pairs

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

Question			Answer	Marks	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 <u>antigen</u> ✓ *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**	*Ignore prompts and mark as prose* **9 ALLOW** allows <u>specific</u> vaccines to be produced
			Total	**11**	

Question			Answer	Marks	Guidance
22	(a)		*saturated fatty acids have…* carboxyl(ic group) / COOH / OH / hydroxyl / oxygen atoms ✓	1	*Mark first response only* **IGNORE** hydroxide
	(b)	(i)	**1** bacteria gain , nutrient / mineral / food , from , it / detergent ✓ **2** structures / AW (in fig. 21.1) contain <u>only</u> C **and** H ✓ **3** bacteria need (named) elements other than C and H ✓ example of other element linked to use in bacterium ✓ **4** absence of other elements is a <u>limiting factor</u> (for bacterial growth) ✓ **5**	3 max	**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 <u>controls</u> surface area or elements available ✓ (information about) elements / AW , present in the detergent ✓	1 max	**ALLOW** e.g. grow bacteria on small droplets with and without detergent
	(c)		<u>adapted</u> to occupy the (oil spill) , <u>niche</u> / <u>environment</u> ✓ outcompete other , bacteria / species ✓	1 max	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td>oil is acting as selective agent / selection of bacteria that were able to digest oil ✓</td><td></td><td></td></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>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></tr>
</table>

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

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Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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