GCE

Biology A

H420/02: Biological diversity

Advanced GCE

Mark Scheme for Autumn 2021

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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

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

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

Question			Answer	Marks	AO element	Guidance
1			C ✓	1	AO1.1	
2			A ✓	1	AO2.1	
3			D ✓	1	AO1.2	**ALLOW** A
4			C ✓	1	AO2.5	
5			B ✓	1	AO1.2	
6			A ✓	1	AO1.2	
7			A ✓	1	AO1.1	
8			B ✓	1	AO2.1	
9			C ✓	1	AO2.2	
10			B ✓	1	AO1.2	
11			C ✓	1	AO2.4	
12			B ✓	1	AO2.4	
13			D ✓	1	AO2.7	
14			B ✓	1	AO1.1	
15			C ✓	1	AO2.1	
			Total	15		

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	phosphate ✓ deoxyribose ✓ guanine ✓	3	1.1 2.1	**IGNORE** PO_4 **DO NOT CREDIT** dioxyribose **DO NOT CREDIT** if any other sugar mentioned **IGNORE** G **DO NOT CREDIT** if any other base mentioned
		(ii)	phosphodiester ✓ condensation ✓	2	1.1 1.2	
16	(b)	(i)	**1** amplify (DNA fragment) with PCR ✓ **2** cut / digest , with restriction enzyme ✓ **3** separate / AW , using, electrophoresis / electric current through gel ✓ **4** transfer (fragments) to , paper / membrane / nylon ✓ **5** add , radioactive / fluorescent , probe ✓ **6** use , x-rays / UV light , to view (position of DNA fragments) ✓	4 max	1.2	**IGNORE** steps in implausible sequence **4 ALLOW** (Southern) blot **6** viewing method must not contradict probe used.
		(ii)	Individual C ✓ *idea of* highest number of matches (3) that cannot have come from mother	2	3.1	 **DO NOT CREDIT** if bands are described as **,** genes / bases

Question			Answer	Marks	AO element	Guidance
			or 5th (child) band (from left) can only have come from C ✓			
		(iii)	*idea of* assessing disease risk ✓ classification / species identification ✓	**1 max**	1.1	**ALLOW** reference to horsemeat in burgers **ALLOW** ascertain ancestry of (extinct) species
16	**(c)**	**(i)**	editing of primary , mRNA / transcript ✓ not present in mature mRNA ✓ not translated ✓ regulatory , sequences / genes ✓	**2 max**	1.2	**IGNORE** introns are non-coding (as this is not an explanation) **ALLOW** introns removed **ALLOW** used to make , tRNA / rRNA
		(ii)	not selected against / AW ✓	**1**	2.5	**ALLOW** doesn't affect survival
16	**(d)**		synthetic ✓ *Escherichia* ✓ phylogeny / phylogenetics ✓	**3**	1.1 2.1	

Question			Answer	Marks	AO element	Guidance
17	**(a)**	**(i)**	**FIRST CHECK ON ANSWER LINE** **If answer = 8.85 x 10^9 award 2 marks** 8.94 x 10^9 - 9.08 x 10^7 correct ✓	**2**	2.6	*If answer incorrect…* **ALLOW** max 1 mark for 8.8492 x 10^9 / 8.84 x 10^9 / correct answer not in standard form
		(ii)	measuring changes in dry mass over time / AW ✓	**1**	3.3	**ALLOW** e.g, dry leaves after 24h and weigh them then repeat at different times of year.

Question			Answer	Marks	AO element	Guidance
		(iii)	misses , chloroplasts / parts that photosynthesize ✓ (rate of photosynthesis) limited by another factor ✓	1 max	1.1	**ALLOW** transmitted
		(iv)	*idea that* heather is less easily digested ✓ **ora** (because of) cellulose (cell walls) / lignin (in woody parts) ✓	2	2.5	**ALLOW** only part of the plant is eaten
17	(b)	(i)	**FIRST CHECK ON ANSWER LINE** **If answer = 767 or 768 award 2 marks** 545 x 100/71 ✓	2 max	2.2	*If answer incorrect* **ALLOW** max 1 mark for 76.6 **ALLOW** max 1 mark for 1535 (quoting individuals rather than pairs)
		(ii)	deliberate killing to maintain grouse numbers / pollution / pesticides / disease / loss of another food source / competition from new predator ✓	1	2.5	*Mark as prose* **IGNORE** habitat loss **ALLOW** hunting
17	(c)	(i)	(species are conserved) in their (natural) habitat ✓	1	2.1	
		(ii)	controlled grazing ✓ monitoring of population(s) ✓ restricting human access ✓ remove / AW , invasive species ✓	1 max	2.1	**ALLOW** cutting heather **ALLOW** prevention of grazing **IGNORE** fence off the area **ALLOW** maintaining footpaths **IGNORE** 'don't allow building' **ALLOW** remove weeds

Question			Answer	Marks	AO element	Guidance
17	(d)*		***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.***			
			Level 3 (5–6 marks) Describes some stages of succession with reference to general principals and key terms **AND** explains why heather moorland is deflected succession. *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 some stages of succession with reference to general principles **OR** describes one stage of succession with reference to general principles **AND** explains why heather moorland is deflected succession **OR** describes some stages of succession **AND** explains why heather moorland is deflected succession. *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)** Mentions some stages of succession **OR** outlines the general principles **OR** explains why heather moorland is deflected succession.	**6**	1.2 2.5	**Indicative points may include** *AO1.2* *Stages* Pioneer community • begins with bare rock • arrival as seeds or spores • pioneer species have certain adaptations, e.g. nitrogen-fixation Intermediate community • herb species, including grasses • followed by shrubs and trees Climax community • dominance by a few tree species • little change over time *General principles* • seral stages • community and decomposition changes composition of soil • increased organic, nitrate or water content *AO2.5* Heather moorland is deflected succession because…

Question			Answer	Marks	AO element	Guidance
			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.*			• climax community is prevented from developing As a result… • plagioclimax • heather is a shrub

Question			Answer	Marks	AO element	Guidance
18	**(a)**		phosphate (on head), is hydrophilic / bonds with water (molecules) ✓ (two) fatty acid tails are hydrophobic ✓ heads orientate towards water / tails orientate towards other fatty acids / tails orientate away from water , (so a bilayer forms)✓	**3**	2.1 2.5	**DO NOT CREDIT** reference to incorrect bond, e.g. covalent This point is for a description of why a bilayer forms and key terms are not required
18	**(b)**	**(i)**	ruled lines and a border **and** correct numbers in each column **and** absorbance **and** pH **and** mean in headings ✓ pH in left hand column ✓ units (%) in headings and not within table ✓ means recorded to one decimal place ✓	**4**	3.3 3.4	**ALLOW** means recorded as whole numbers
		(ii)	(low pH) denatures / changes tertiary structure of , (membrane) proteins ✓	**2 max**	2.1	

Question			Answer	Marks	AO element	Guidance
			therefore membrane permeability (to pigment) is increased ✓			**CREDIT** only in the context of membrane protein structure having been changed
		(iii)	use pH buffer range with narrower intervals ✓ pH (buffers) , close to pH6 / between pH5 and pH6 / between pH5 and pH7 ✓	**2**	3.3	**ALLOW** stated values (must be more than one) at interval of less than 1 **ALLOW** stated value of buffer within the range pH5 to pH7 'test more values between pH5 and pH6' = 2 marks. 'test at pH 6.5' = 1 mark (mp2)

Question			Answer	Marks	AO element	Guidance
19	**(a)**	**(i)**	(bird) females have two different (sex) chromosomes / AW ✓ **ora**	**1**	2.1	**ALLOW** human females are homozygous **IGNORE** male mammals have X and Y chromosomes **DO NOT CREDIT** chromosomes described as , alleles / genes
		(ii)	*Parents' phenotype* red male blue female ✓ *Gametes* Z^A, Z^b Z^B, W ✓ *Offspring genotypes* Z^AZ^B, Z^BZ^b, Z^AW, Z^bW ✓ *Offspring phenotypes* red male, blue male, red female, brown female ✓	**4**	2.1	**ALLOW ECF** if no sexes given for mp1 or mp4 but colours correct

<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></td><td></td><td></td><td></td></tr>
<tr><td>19</td><td>(b)</td><td>(i)</td><td>
<table>
<tr><th>phenotypes</th><th>observed number (O)</th><th>expected number (E)</th><th>O-E</th><th>$(O-E)^2$</th><th>$\frac{(O-E)^2}{E}$</th></tr>
<tr><td>healthy female</td><td>5</td><td>4.5</td><td>0.5</td><td>0.25</td><td>0.056</td></tr>
<tr><td>healthy male</td><td>3</td><td>2.25</td><td>0.75</td><td>0.56</td><td>0.249</td></tr>
<tr><td>haemophilia male</td><td>1</td><td>2.25</td><td>-1.25</td><td>1.56</td><td>0.693</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td></td><td>χ^2 =</td><td>0.998</td></tr>
</table>
</td><td>2</td><td>2.6</td><td>IGNORE decimal places</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>5.991 ✓</td><td>1</td><td>2.2</td><td>ALLOW number circled or otherwise indicated in table</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>student is incorrect because , chi-squared / calculated , number below critical value ✓

greater than , 5% / 10% , probability that any difference is due to chance ✓

idea that statistical tests only gives a probability ✓</td><td>2 max</td><td>3.2</td><td>ALLOW no significant difference between observed and expected

ALLOW numbers too low to be confident about conclusion</td></tr>
<tr><td>19</td><td>(c)</td><td></td><td>(hypophosphatemic rickets allele is) dominant ✓
because occurs in daughter of an affected father ✓</td><td>2 max</td><td>3.1</td><td>ALLOW it / gene , is dominant</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
			on X chromosome / not on Y chromosome , because , it occurs in females (and males) / affected fathers always pass to daughters ✓			

Question			Answer	Marks	AO element	Guidance
20	**(a)**	**(i)**	-1.8 ✓	**1**	2.2	
		(ii)	**FIRST CHECK ON ANSWER LINE** **If answer = 0.24 award 2 marks** 0.8 / 3.4 ✓	**2**	2.2	*If answer incorrect…* **ALLOW** max 1 mark for 0.2 / correct answer to >2 s.f. / 24%
		(iii)	*supports because…* **1** two peaks ✓ **2** (at) 0 and , 1.2 / 1.4 ✓ *does not support because…* **3** second / AW , peak is not much higher than background ✓ **4** second / AW , peak represents a small number of birds ✓ **5** *idea that* there could be other explanations for more birds between 1.2 and 1.4 (a.u.) ✓ **OR if marking points 3, 4 or 5 have not been awarded** *does not support because…* **6** there is only one peak ✓ **7**	**3 max**	3.1 3.2	**1 ALLOW** not a normal distribution

Question			Answer	Marks	AO element	Guidance
			idea that more likely directional selection as peak closer to left hand side ✓			
20	**(b)**	**(i)**	sympatric ✓	**1**	1.2	
		(ii)	*idea that* individuals choose to mate only with other individuals with similar sized beaks ✓	**1**	1.2	**CREDIT** sexual selection **ALLOW** different , mating seasons / courtship rituals
		(iii)	(DNA) found in all organisms ✓ some / AW , sequences highly conserved ✓ comparison (of DNA between species) ✓ similar (base) sequence indicates recent common ancestor ✓ **ora**	**2**	1.1	 **ALLOW** look at similarities in DNA **IGNORE** closely related

Question			Answer	Marks	AO element	Guidance
20	(c)*		***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.***			
	(c)		**Level 3 (5–6 marks)** Explains how genetic variation, differential survival and the passing on of alleles to the next generation act to increase the proportion of the population with a beak length of around 11mm and makes appropriate use of the graph data to support explanation. *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 how natural selection acts to increase the proportion of the population with a beak length of around 11mm. *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 how natural selection favours those in the population with an average phenotype **OR** that natural selection favours finches with a beak length of around 11 mm.	**6**	2.5 3.2	**Indicative points may include** *AO2.5* Genetic variation • pre-existing • sexual reproduction • meiosis • mutation Differential survival • overproduction of offspring • finches with extreme beak depth less likely to survive • reason for birds with very small or large beaks not surviving Inheritance • survivors possess alleles for average beak depth • alleles for average beak depth more likely to be inherited by offspring • increase frequency of these alleles from one generation to the next *AO3.2*

Question			Answer	Marks	AO element	Guidance
			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.*			Use of figures from graph • bell-shaped curve • skewed to right • beak depth with peak survival is 11.2 mm • no birds survived with beaks of 7.4 mm or less • no birds survived with beaks of 11.6 mm or more
	(d)		similar ideas to Darwin ✓ arrived at independently ✓ presented / published (paper) , together ✓ *idea of* increased weight of evidence ✓	**2 max**	1.1 3.2	

Question			Answer	Marks	AO element	Guidance
21	**(a)**		suckers / stolons / tubers / rhizomes / bulbs ✓	**1**	1.1	**ALLOW** other correct methods
21	**(b)**		meristem(atic) ✓	**1**	1.1	
21	**(c)**			**2 max**	1.2	*All marks are for the idea of multiplication – key terms, such as explant are not essential*

Question			Answer	Marks	AO element	Guidance
			many / AW, explants taken from , original / parent , plant ✓ calluses subdivided ✓ (meristems from) plantlets can be subdivided ✓			
21	(d)	(i)	**FIRST CHECK ON ANSWER LINE** **if answer is 48(%), award 2 marks.** 16.1/33.8 ✓	**2**	2.7	*If answer incorrect…* **ALLOW** max 1 mark for correct answer (47.633) to > 2 s.f.
		(ii)	*Independent variable* BAP concentration ✓ *Dependent variable* shoot length ✓ *Controlled variables* *Any two from…* time light intensity lighting regime temperature (named) nutrient availability (in growth medium) water availability concentration of other plant hormones pH (of growth medium) ✓	**3**	3.3	**IGNORE** mean Mark the first two answers only **ALLOW** composition of , growth medium / agar

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