



MARKING GUIDANCE

SECTION A

Question	Answer	Marks
01	D	1
02	B	1
03	D	1
04	C	1
05	B	1
06	D	1
07	A	1
08	D	1
09	B	1
10	C	1
11	D	1
12	A	1
13	B	1
14	A	1
15	D	1
TOTAL		15



SECTION B

Question	Answer	Additional Guidance	Marks
16a	1. Scanning electron microscope (SEM) Because the image is 3D OR shows a surface view		2
16b	1. Calculate magnification using scale bar. length in $\mu\text{m}/4$ OR length in $\text{mm}/4000$ 2. Correct length of pollen grain measured in mm Correct answer	If incorrect answer allow 1 mark for correct rearrangement of equation $A=I/M$ or correct conversion of mm to μm Measurements will depend on your screen size/ print size	3
16c	Ability to see two objects that are close together as separate objects	Accept ability to distinguish two objects	1
16d	18		1
16e	<ul style="list-style-type: none">• Active site has specific shape/tertiary structure.• Complementary to (bonds in) pectin• (catalyses the) hydrolysis of glycosidic bonds (in pectin)		3



16f	<p>Any two pairs from:</p> <p>Advantage = low cost Explanation = many microorganisms require only low temperatures / few energy requirements / nutrients for growth are cheap (e.g. waste materials)</p> <p>Advantage = large numbers can be produced quickly / high yield of product Explanation = short generation time / reproduce quickly</p> <p>Advantage = Can be grown anywhere a fermenter can be set up Explanation = Take up less space than crops/not seasonal/not climate dependent</p> <p>Advantage = Can make products with less contamination than chemical processes Explanation = less purification/ downstream stages needed</p> <p>Advantage = Can be easily genetically modified Explanation = can be made to produce useful products.</p>	<p>2 marks available for advantages</p> <p>2 marks available for related explanations</p> <p>The explanation must be appropriate for the advantage it is linked to.</p>	4
TOTAL			14



Question	Answer	Additional Guidance	Marks
17a	1. Cell X 2. Multilobed nucleus		2
17b	Specific or humoral	Accept: Adaptive	1
17c	1. (Artificial) <u>active</u> immunity 2. because antibodies and memory cells are being produced in the body/humoral response triggered		2
17d	Any three from: <ul style="list-style-type: none">• Memory T cells• Recognize HPV antigen• T helper cells activate (memory) B cells to produce antibodies• T helper cells stimulate (cytotoxic) T killer cells destroy cells infected with the virus		3
17e	10.5 – 6 = 4.5 per 100,000 4 years 1.125 cases per 100,000 per year	1 for correct reading from graph if incorrect answer Accept 1.13	2
17f	A discussion that includes any five from the following: For: <ul style="list-style-type: none">• decrease in cervical cancer cases per 100,000 seen since vaccine in 2005/continuous decrease in cancer cases as number vaccinated increased• not contracting the HPV virus/being immune would reduce the chance of cervical cancer	Must have for and against arguments and must have data to support points from the graph	5



	<ul style="list-style-type: none">• Any data point from graph to support these statements e.g. % decrease or fall in diagnosis numbers.• May be a delay in seeing effect due to age of vaccination <p>Against:</p> <ul style="list-style-type: none">• data does not show direct correlation/idea that need to plot % vaccination against number of cervical cancer deaths to judge correlation• there was a decrease before the vaccine/ decrease occurred/began when very few children were vaccinated• decrease slowed down/less rapid from 2012• other factors could be causing decrease e.g. more testing/screening/awareness• no data on long term effects of vaccine/how long it lasts• Despite nearly all children vaccinated there are still cervical cancer cases which could suggest other causes• No statistical tests e.g. correlation		
TOTAL			15



Question	Answer	Additional Guidance	Marks
18a	Saprobionts/ decomposers	Accept: saprophytes / saprotrophs/ saprobiotic	1
18b	$24,525 \times 0.127 = 3,114.675$ $3,114.675 \times 0.057 = 177.53$ 180	1 mark if not correct sig fig 180 gets 2 marks	2
18c	1. Some biomass is used for respiration 2. Energy lost as heat		2
18d	1. Increased temperature 2. Increased rate of photosynthesis OR 1. Increased light intensity/more light energy 2. increases rate of photosynthesis		2
18e	1. More herring as less are being caught/eaten by tuna 2. So less zooplankton as more are being eaten by herring		2
18f	1. The number of fish being caught each year is increasing 2. But the number of fish in the population able to breed is decreasing 3. Not enough fish are being left to breed to replace the fish being caught/death rate exceeding birth rate		3
18g	1. Capture and count (spawning age fish) 2. carefully mark to avoid detection by prey/predation/prevent feeding etc. and release 3. Recapture, count marked and unmarked		3



18h	<ol style="list-style-type: none">1. Fewer respiratory losses as less energy used for movement/catching food/avoiding predation2. So greater GP/efficiency in energy transfer/more energy from food converted to biomass		2
18i i	<p>Any two from:</p> <ul style="list-style-type: none">• Fishing quotas• Mesh size/net hole size• Trawler size/limit days at sea• Penalties and sanctions for overfishing or catching too many young fish• Monitoring/surveillance• Publicity/public education		2
18i ii	<p>Any one from:</p> <ul style="list-style-type: none">• Very large area• Expensive to monitor/use satellites• Monitoring can be prevented by weather/seasonal issues• Relying on self-reporting of obeying rules which can be false/lies• Extra fish caught being returned but dead		1
TOTAL			20



Question	Answer	Additional Guidance	Marks									
19a	Female birds are heterozygous/have two different sex chromosomes	Allow converse about human female gametes	1									
19b	Sex-linkage		1									
19c	Blue male = $Z^B Z^B$ Brown female = $Z^C W$		2									
19d	1. Female = $Z^B W$ 2. Male gametes = Z^A Female gametes = Z^B and W 3. <table border="1" style="margin-left: 40px;"> <tr> <td></td> <td>Z^A</td> <td>Z^A</td> </tr> <tr> <td>Z^B</td> <td>$Z^A Z^B$</td> <td>$Z^A Z^B$</td> </tr> <tr> <td>W</td> <td>$Z^A W$</td> <td>$Z^A W$</td> </tr> </table> 4. Ash red male or Ash red female 50% probability		Z^A	Z^A	Z^B	$Z^A Z^B$	$Z^A Z^B$	W	$Z^A W$	$Z^A W$	Accept lower case letters for A and B Accept Z^{B-} for $Z^B W$	4
	Z^A	Z^A										
Z^B	$Z^A Z^B$	$Z^A Z^B$										
W	$Z^A W$	$Z^A W$										
19e	1. Females need to have only one allele (because one chromosome does not have the gene) 2. Males need two recessive alleles / must be homozygous recessive / could have dominant and recessive alleles / could be heterozygous / carriers	Answers should be in context of alleles rather than chromosomes	2									



19f	<p>Indicative points:</p> <p>Effect on population:</p> <ul style="list-style-type: none">• Increase in frequency of desired (named) characteristics in the population• Inbreeding reduces genetic diversity of gene pool (inbreeding depression)• Chances of inheriting harmful recessive alleles is increased• Makes the population more susceptible to pathogens/communicable diseases• Could have other inherited health issues <p>How to reduce impact:</p> <ul style="list-style-type: none">• Avoid breeding closely related individuals• Back cross with wild populations to increase hybrid vigour• Idea of preserving/conserving genetic diversity• Could measure/estimate genetic diversity (described method e.g. measuring number of heterozygous loci) to monitor population	<p>Level 3 (5–6 marks) Provides multiple descriptions of the effects of selective breeding on the population and a detailed explanation of the ways the impact of breeding can be reduced. The answer is clear and logically structured and uses correct scientific terminology to an appropriate level. All the information in the answer is relevant.</p> <p>Level 2 (3–4 marks) Provides both descriptions of the effect of selective breeding on populations and suitable explanations of ways to reduce impact. The answer is reasonably structured and contains appropriate scientific language. Most points are relevant.</p> <p>Level 1 (1–2 marks) Describes at least one effect of selective breeding on the population, may or may not include an explanation of how to reduce impact. There is little structure to the answer. The answer contains inappropriate use of technical terms or irrelevant information.</p> <p>0 marks No response or response contains no relevant points.</p>	6
TOTAL			16



Question	Answer			Additional Guidance	Marks															
20a	<table border="1"> <thead> <tr> <th data-bbox="376 277 613 316">Behavioural</th> <th data-bbox="613 277 869 316">Physiological</th> <th data-bbox="869 277 1102 316">Anatomical</th> </tr> </thead> <tbody> <tr> <td data-bbox="376 316 613 395"></td> <td data-bbox="613 316 869 395"></td> <td data-bbox="869 316 1102 395" style="text-align: center;">x</td> </tr> <tr> <td data-bbox="376 395 613 475" style="text-align: center;">x</td> <td data-bbox="613 395 869 475"></td> <td data-bbox="869 395 1102 475"></td> </tr> <tr> <td data-bbox="376 475 613 555"></td> <td data-bbox="613 475 869 555" style="text-align: center;">x</td> <td data-bbox="869 475 1102 555"></td> </tr> <tr> <td data-bbox="376 555 613 635"></td> <td data-bbox="613 555 869 635"></td> <td data-bbox="869 555 1102 635" style="text-align: center;">x</td> </tr> </tbody> </table>			Behavioural	Physiological	Anatomical			x	x				x				x	1 mark for each correct column	3
Behavioural	Physiological	Anatomical																		
		x																		
x																				
	x																			
		x																		
20b	<p>Any two from:</p> <ul style="list-style-type: none"> • Hair around stomata <ul style="list-style-type: none"> ○ trap water vapour / moisture and reduce water (vapour) potential gradient / diffusion gradient • Stomata, in pits / sunken pits <ul style="list-style-type: none"> ○ trap water vapour/ moisture and reduce water (vapour) potential gradient / diffusion gradient • Thick(er) cuticle / wax layer <ul style="list-style-type: none"> ○ (which is) waterproof / (relatively) impermeable • Fewer stomata <ul style="list-style-type: none"> ○ reduces diffusion (of water vapour) • Stomata close, during the day <ul style="list-style-type: none"> ○ reduces diffusion (of water vapour) 			<p>Adaptation must be linked to an appropriate explanation.</p> <p>DO NOT ACCEPT 'water' for water vapour throughout</p>	2															



20ci	<ul style="list-style-type: none">• <u>Stabilising</u> selection• Mean (number of spines) has not changed/stays the same (~100)• Range (in number of spines) has <u>decreased</u> from 50-155 in A to 70-130 in B/few cacti survive if they have the extremes most in the middle/individuals in the mean group has increased	Range can be within those numbers as long as B is shown to be smaller	3
20cii	Any three from: <ul style="list-style-type: none">• Number of individuals/frequency with the mean spine number in the population has increased/been selected for OR the number of spines at the extremes has reduced• Because there are two/competing <u>selection pressures</u>.• If cacti had too few spines, they would be eaten by peccaries and if they had too many spines, they would be parasitized by the insects• Being close to the mean spine number increases the chance of survival		3
TOTAL			11



Question	Answer	Additional Guidance	Marks
21ai	Secondary	Accept: deflected	1
21aii	Plagioclimax		1
21b	1. To create new/nutritious/young growth or increase plant biodiversity OR To prevent larger species from growing/prevent it reaching climax community 2. For grazing animals (named e.g. sheep, cattle, deer)		2
21c	There is no significant difference between number of heather plants on each moor	Must contain "no" and "significant difference"	1



21d	<table border="1" data-bbox="416 272 1104 786"> <thead> <tr> <th>Moor</th> <th>0</th> <th>E</th> <th>$O - E$</th> <th>$(O - E)^2$</th> <th>$\frac{(O - E)^2}{E}$</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>30</td> <td>45</td> <td>-15</td> <td>225</td> <td>5</td> </tr> <tr> <td>2</td> <td>63</td> <td>45</td> <td>18</td> <td>324</td> <td>7.2</td> </tr> <tr> <td>3</td> <td>42</td> <td>45</td> <td>-3</td> <td>9</td> <td>0.2</td> </tr> </tbody> </table> <p data-bbox="371 826 528 866">$\chi^2 = 12.4$</p>	Moor	0	E	$O - E$	$(O - E)^2$	$\frac{(O - E)^2}{E}$	1	30	45	-15	225	5	2	63	45	18	324	7.2	3	42	45	-3	9	0.2	Award 2 marks for correct χ^2 with no table workings 1 mark if at least 2 rows of the data table are correct	2
Moor	0	E	$O - E$	$(O - E)^2$	$\frac{(O - E)^2}{E}$																						
1	30	45	-15	225	5																						
2	63	45	18	324	7.2																						
3	42	45	-3	9	0.2																						
21e	<ul data-bbox="371 911 1104 1169" style="list-style-type: none"> As only 5% probability that differences are due to chance/95% probability that differences are significant. Student should reject the null hypothesis/ Students can conclude there is a significant difference between the number of heather plants on the moors 		2																								
TOTAL			9																								