COMPONENT 2 - CONTINUITY OF LIFE

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct relevant alternative responses which are not recorded in the mark scheme.

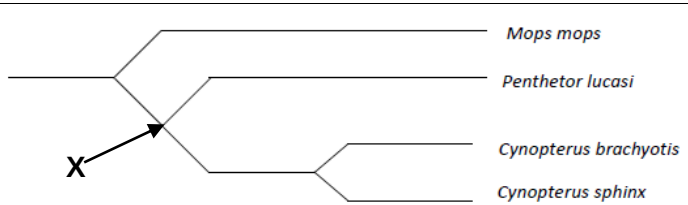
Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement. Award the middle mark in the level if most of the content statements are given and the communication statement is partially met. Award the lower mark if only the content statements are matched.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	*(a)*	(i)		Simpsons's Index is a better measure of biodiversity As it provides information on the number of species and also the number of individuals of each species while species richness only tells you the number of species present (1)	1			1		
		(ii)		Use the capture/recapture technique / Lincoln Index (1) {Trap/catch} samples of different species of mammal, mark and release, {trap/catch} second sample, calculate proportion of marked animals. (1)	2			2		2
		(iii)		Trapping animals could cause harm / marking them could make them more visible to {prey / predators} (1) Numbers of animals re-caught in second sample could be lower (1)	2			2		2
	(b)	(i)				1		1		
		(ii)		A = *Mops mops* B = *Cynopterus sphinx* C = *Penthetor lucasi*			1	1		
	(c)			insects have a higher fat content than fruit and fat produces nearly twice the energy per g through respiration than carbohydrate so less needs to be eaten(1) fats /fatty acids and glycerol contain more hydrogen atoms than glucose (1) therefore, {more H donors / reduced NAD or FAD} produced to pass H atoms to electron transport chain (1)	1	2		3		
				Question 1 total	**6**	**3**	**1**	**10**	**0**	**4**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*	(i)		Sickle cell trait must provide protection against malaria (1)			1	1		
		(ii)		Increase the sample size (1) Account for age / sex (1)			2	2		2
	(b)			q^2 = 1/625 =0.0016, q = 0.04 (1) $p + q = 1$, p = 1.0 – 0.04 = 0.96 (1) (1 for each of working out each of q and p if answer not correct) $2pq = 2pq$ = 2 x 0.04 x 0.96 = 0.0768 (1) Number = 0.0768 x 1000 = 76.8/77 (1)		2	2	4	4	
	(c)			In Africa the proportion of people with sickle cell trait would increase but in the USA the number of people with sickle cell trait would decrease(1) People with sickle-trait have a selective advantage so are less likely to be killed by malaria (1) More will survive to pass on the sickle allele to the next generation (1) In the USA few cases of malaria so no selective advantage (1) Sickle cell trait is a disadvantage and selected against (1)		1 1	1 1 1	5		
				Question 2 total	**0**	**4**	**8**	**12**	**4**	**2**

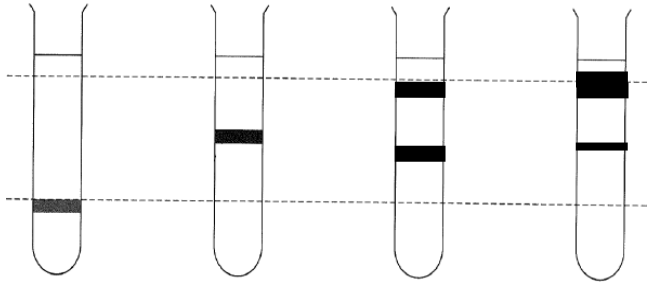
<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>3</td><td>(a)</td><td>(i)</td><td></td><td>
<table>
<tr><th>Description</th><th>Name of cell</th><th></th></tr>
<tr><td>... meiosis</td><td>Primary and secondary spermatocytes</td><td>(1)</td></tr>
<tr><td>... mitosis</td><td>spermatogonium</td><td>(1)</td></tr>
<tr><td>... protection ...</td><td>Sertoli cell</td><td>(1)</td></tr>
<tr><td>... differentiation...</td><td>spermatid</td><td>(1)</td></tr>
</table>
</td><td>4</td><td></td><td></td><td>4</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>Spermatogonia divide to produce primary spermatocytes and each primary spermatocyte produces 4 spermatids (1)</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>Protein (1)
Nucleolus involved in producing rRNA / ribosomes and ribosomes carry out protein synthesis (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iv)</td><td></td><td>Endocytosis / phagocytosis (1)</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td></td><td>A = LH
B = oestrogen
C = progesterone
3 ✓ = (2) ; 2 ✓ = (1) ; 1or 0 ✓ = 0</td><td>3</td><td></td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>18 days</td><td></td><td>1</td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 3 total</td><td>9</td><td>3</td><td>0</td><td>12</td><td>0</td><td>0</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*			A seed is surrounded by the testa only / a fruit originates from the pericarp (1) a barley grain is a fruit because it is surrounded by the testa and the pericarp (1)	2			2		
	(b)			Number of chromosomes in embryo cells = 14 (1) Because of double fertilisation (1) Endosperm cells are triploid / formed from fusion of 1 male gamete and 2 polar nuclei each of which has 7 chromosomes(1) Embryo cells are diploid – fusion of 1 male gamete and 1 female gamete(1)		1 1 1	1 1	4		
	(c)			The mass lost from the endosperm must be used to increase the mass of the embryo (1) As mass of embryo is increasing but plant cannot produce biomass through photosynthesis (1)			2	2		
	(d)	(i)		Volume of agar = 3.142 x 1.25^2 x 0.5 (1) [conversion of mm to cm] Mass of agar = 2.4546... / 100 (1) Mass of agar = 2.46 x 10^{-2} g (1)		3		3	3	
		(ii)		aleurone layer (1) gibberellin (1)	2			2		
		(iii)		range of seeds of different ages (1) Measure diameter/area of clear zone (1) Two controlled variables - Same mass of seeds +Same/ fixed time (1) Repeats (1) Reference to suitable control (1)			5	5		5
				Question 4 total	**4**	**5**	**9**	**`18**	**3**	**5**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*			Enzymes would digest the viral DNA and destroy genes / make it impossible for viral proteins to be made (1)		1		1		
	(b)	(i)		3450-2675 = 775 (1) +30 = 805 bp (1) 2 marks for correct answer with units		2		2	2	
		(ii)		EcoRI **and** HindIII (1)		1		1		
	(c)	(i)	I II III	breaks hydrogen bonds/ causing DNA strands to separate (1) allows {primers/short pieces of DNA} to {anneal/bind/join} (1) Enzyme adds complementary nucleotides / extension/ forms the phosphodiester bonds in the sugar-phosphate backbone (1)	3			3		
		(ii)		DNA is attracted to the positive electrode due to its negative charge on the phosphate group (1) Smaller fragments find it easier to migrate through the pores in the gel and so travel further than larger fragments in the same time (1) Fragment size can be estimated by running a DNA ladder (which contains fragments of known size) alongside (1)	3			3		3
		(iii)		From sequencing the expected fragment size = 52bp **and** From gel result band produced is approximately 50bp/half way between 75 bp and 25 bp ladder band OWTTE (1) Therefore good agreement between the results of the two tests (1)			2	2		
		(iv)		Use more DNA fragments of values between 25 and 75/ smaller size than 75/ OWTTE (1)			1	1		1
				Question 5 total	**6**	**4**	**3**	**13**	**2**	**4**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td></td><td>Parental genotypes RrYy rryy (1)
Gametes RY, Ry, rY and ry ry (1)
F1 genotypes RrYy Rryy rrYy rryy (1)
Genotype linked to phenotype wrinkled yellow wrinkled green smooth yellow smooth green (1)
ratio 1 : 1: 1: 1 (1)</td><td></td><td>5</td><td></td><td>5</td><td>1</td><td></td></tr>
<tr><td colspan="10"></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td></td><td>
<table>
<tr><th>Observed
O</th><th>Expected
E</th><th>(O-E)</th><th>(O-E)^2</th><th>$\frac{(O-E)^2}{E}$</th></tr>
<tr><td>31</td><td>27</td><td>4</td><td>16</td><td>0.592593</td></tr>
<tr><td>22</td><td>27</td><td>-5</td><td>25</td><td>0.925926</td></tr>
<tr><td>29</td><td>27</td><td>2</td><td>4</td><td>0.148148</td></tr>
<tr><td>26</td><td>27</td><td>-1</td><td>1</td><td>0.037037</td></tr>
<tr><td>108</td><td>108</td><td></td><td></td><td></td></tr>
</table>
χ^2 = 1.07 (1.070374) (3) for correct value of χ^2

If incorrect award up to 2 marks:
correct value of expected results(1)
correct values of $(O-E)^2$ (1)</td><td></td><td>3</td><td></td><td>3</td><td>3</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>Critical value from table = 7.82(1)
Therefore conclusion is valid(1)
Because χ^2 value < critical value at 0.05 (1)
Deviation is due to chance(1)</td><td></td><td>2</td><td>2</td><td>4</td><td>2</td><td></td></tr>
<tr><td colspan="10"></td></tr>
<tr><td colspan="4"></td><td>Question 6 total</td><td>0</td><td>10</td><td>2</td><td>12</td><td>6</td><td>0</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*			(tumour) damages basement membranes in glomerulus(1) so red blood cells can pass through (1) OR (tumour) could increase blood pressure in kidneys(1) which causes damage to capillaries / podocytes in glomerulus (1)		2		2		
	(b)	*(i)*		 After 2 divisions: intermediate and light equal amounts (1) After 3 divisions: intermediate and light more light than intermediate e.g. shown as thicker or wider line (1)	2			2		
		(ii)		Semi-conservative (1)	1			1		
		(iii)		After 1 division DNA mixture of heavy and light DNA (1) DNA after 1 division must be made from one strand of heavy and one light / each molecule must contain 1 original and 1 new strand of DNA(1)	2			2		
	(c)	*(i)*	I	High level: stays in period of normal cell activity longer / continues to perform particular function (1)		1		1		
			II	Low level: decreases time for cell division/ Increases rate of growth / repair (1)		1		1		
		(ii)		(abnormally low levels of p27) results in cells entering S phase too quickly (1) Speeds up rate of growth to above normal rate / no control on rate of growth (1)		2		2		
	(d)			the phosphate group has a strong negative charge (1) this could change the tertiary structure of p27 (1) so p27 would not bind to the active site of the target enzyme (1)		3		3		
				Question 7 total	**5**	**9**	**0**	**14**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8				Indicative content Because only members of the same species can interbreed to produce fertile offspring there are only three species present. ● Coyote, wolf and dingo can all interbreed to produce fertile offspring and are therefore one species. ● Black-backed and side-striped jackals cannot interbreed successfully with any other shown, therefore they are both separate species. Following evolution from a common ancestor the canines have migrated to different parts of the world where there would be different selective pressures in different habitats such as differences in climate, predators and food availability. There is a variation in the different populations of canines caused by mutation, so individuals in the populations would have variations giving them a selective advantage to survive under these different selection pressures. Natural selection would result in there being morphological differences between the canines. It would appear that the wolf, dingo, and coyote diverged relatively recently as even though they are geographically separated they could still interbreed. The side-striped jackal and black-backed jackal appear to have diverged less recently allowing more time for speciation to occur. Allopatric speciation has occurred between those canines that can produce fertile offspring and the black-backed and side-striped jackals due to geographical isolation, such as the oceans and deserts.	0	7	2	9		

				Sympatric speciation has occurred to produce the black-backed and side-striped jackals as they occupy the same habitat but cannot produce fertile offspring. Isolation mechanisms such as different reproductive cycles; differences in reproductive or courtship behaviour; changes in chromosome numbers / ploidy; different activity times; mechanical isolation; could be the cause of this. **7-9 marks** The candidate gives a full and detailed explanation of why there are only three actual species shown on the map. The effect of natural selection resulting in morphological differences is also clearly explained in terms of survival of the fittest under different selection pressures. Speciation due to both sympatric and allopatric isolation mechanisms are explained in detail to account for the evolution of three species of canine. Some comment made on divergence of the jackals less recently than the other species. *The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions* **4-6 marks** The candidate explains why the black-backed and side-striped jackals are different species to the other canines does not clearly explain why there are only 3 actual species shown. The effect of natural selection resulting in morphological differences is explained in terms of survival of the fittest under different selection pressures. Speciation due to both sympatric and allopatric causes are correctly described and an attempt is made to use these mechanisms to account for the different species of canine shown.						

				The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately. **1-3 marks** The candidate attempts to explain why there are fewer than five actual species shown on the map. Natural selection is used to explain the morphological differences but may not include a clear understanding of the effects of different selection pressures. Mechanisms of speciation due to sympatric and / or allopatric causes are suggested but with insufficient detail to account for the different species of canine shown. *The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.* **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.						
				Question 8 total	**0**	**7**	**2**	**9**	**0**	**0**

COMPONENT 2: CONTINUITY OF LIFE

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Q	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	6	3	1	10	0	4
2	0	4	8	12	4	2
3	9	3	0	12	0	0
4	4	5	9	18	3	5
5	6	4	3	13	2	4
6	0	10	2	12	6	0
7	5	9	0	14	0	0
8	0	7	2	9	0	0
TOTAL	**30**	**45**	**25**	**100**	**15**	**15**