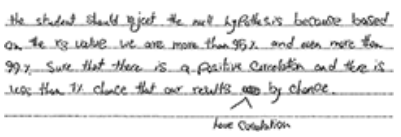
Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	family ✓	1 (AO 2.1)	**Examiner's Comments** The vast majority of candidates achieved this mark. The most frequent incorrect answers were 'class' or 'phylum'. There was evidence of many candidates having written out mnemonic letters.
		ii	1 all / they , are different genera ✓ 2 Tasmanian devil **and** quoll **and** dunnart are in same , family / (taxon) A ✓ 3 (Dasyuridae species) share more recent common ancestor (with one another than with thylacine or numbat) ✓ **ora** 4 all in the same order so likely to have (phylogenetic) relationship ✓	3 max (2 x AO 2.1) (1 x AO 3.1)	**CREDIT** scientific names **1 ALLOW** all / they , are different species **2 ALLOW** thylacine **and** numbat do not share a family with the others **3 ALLOW** share , closer / next , common ancestor **3 ALLOW** more / most , closely related **3 ALLOW** more genetically similar (or higher level descriptions thereof) **3 IGNORE** DNA **4 IGNORE** DNA **Examiner's Comments** This question was well answered, with most responses gaining 2 or more marks - usually for noticing that the three Dasyuridae belonged to the same family. This meant that their evolutionary relationship would be closer than that with the other species in the table. Lower-scoring responses tended to discuss the process of speciation.
		iii	none are in , Thylacinidae / the thylacine's family ✓ idea that further information is required ✓	2 (AO 3.1)	**ALLOW** e.g., DNA sequences not available / classification based on observable features (rather than molecular evidence) **Examiner's Comments** Most candidates gained the first

					marking point, but few achieved the second. Those that did get full marks discussed the absence of further evolutionary information, such as a phylogenetic tree or the fact that the classification information they had been given may have been based on observable features rather than molecular biology.
		iv	no / absence of , cell wall **AND** no / absence of , chloroplasts ✓	1 (AO 2 x 1)	**DO NOT CREDIT** wrong answers Answers can be in any order but both required for 1 mark. **IGNORE** heterotrophic / lysosomes / glycogen granules / centrioles / centrosomes **Examiner's Comments** Fewer than 1 in 5 answers scored the mark here. Common incorrect responses suggested the presence of a nucleus, membrane-bound organelles (notably mitochondria) or 80s ribosomes, all of which are present in plant cells. A few candidates suggested a lack of chlorophyll (as opposed to chloroplasts), but chlorophyll is not really a feature of a cell.
			Total	**7**	
2			B ✓	1	**Examiner's Comments** Only a few candidates were able to identify the correct organism as a prokaryote and select B as the right response. The additional guidance provided in the specification should be used to make sure that all key examples of specific organisms are covered in teaching. Specification point 4.1.1 (a) lists ring rot as an example of bacterial pathogen. The most common incorrect response was A.
			Total	**1**	
3			C ✓	1	**Examiner's Comments** Many candidates correctly identified C as correct, that echolocation had

					developed due to having the same selection pressures. Other candidates incorrectly selected D, believing that environment caused the same mutation. Candidates should be clear that all mutations are random spontaneous events and therefore are not driven by the environment. **Assessment for learning** Examples of convergent evolution and evolutionary niches could be used in teaching to reinforce this concept, such as the placental mole compared to the marsupial mole.
			Total	**1**	
4	a		*idea of* gradual changes in (width of cell wall in) species A over many years ✓ *idea of* no evidence from the graph that the mechanism of evolution is natural selection ✓ *idea of* no evidence that cell wall changes were advantageous (to support natural selection) ✓	2	e.g. 'the width of the cell wall in A becomes smaller than B over millions of years, which suggests evolution' **DO NOT ALLOW** wall of A has increased over many years **Note:** 'shows evidence for evolution by natural selection as changes to A occur over many years' = 1 mark e.g. no evidence of changes to population size (as a result of changes to wall width) **Examiner's Comments** Relatively few candidates read and interpreted the graph correctly. The vast majority of candidates who recognised that the thickness of wall in species A changed over time described at as increasing in thickness. However, the horizontal axis reads with increasing time into the past and the wall actually decreased in thickness over time. Very few candidates separated the

					concepts of evolution and natural selection and many started their response by stating 'the graph does/does not show evidence for evolution by natural selection....'. Some candidates appreciated that there was a change in the cell wall thickness in species A but did not realise that the graph did not give any evidence about what caused the change. While the thickness of wall changing over time is evidence of evolution the graph does not provide evidence of natural selection as there is no information about whether the changes were beneficial or not. Less able candidates often gave an account of natural selection or suggested that species A became extinct or even converged and combined with species B. **Misconception** Evolution and natural selection are not the same thing. Evolution is the concept that species change over time rather than remaining constant. Natural selection is the mechanism by which evolution is believed to occur.
	b		0.979 / rS, is greater than, 0.429 (at p=0.05) / 0.582 (at 0.01) ✓ (therefore) <u>significant</u> (positive) correlation at (p =), 0.05 / 0.01 ✓ (indicates greater than, 95% / 99%, probability that correlation) is not due to chance ✓ H0 / null hypothesis, can be rejected (at p = 0.05 and 0.01) ✓	3 max	**ALLOW** 'student's rs value is greater than the critical value for n = 16' **DO NOT ALLOW** ref to data for other values of n **ALLOW** 'there is a <u>significant</u> (positive) correlation between the two sets of data' **IGNORE** ref to 'strong' correlation **DO NOT ALLOW** ref to negative correlation **ALLOW** 'less than, 1% / 5%, probability that correlation is due to chance' **<u>Examiner's Comments</u>**

					Many candidates were able to gain credit here for stating that the calculated value of rs (0.979) was greater than the critical value for n=16 (0.4294) or for stating that the null hypothesis can be rejected. Few candidates were able to give clear concise responses that explained in full what could be concluded. In particular, candidates do not seem to understand the concept of significance. If the calculated value (0.979) is greater than the relevant critical value (0.4292 or 0.5824) then there is a significant correlation at that level of probability and the correlation is not due to chance. Less able candidates used the critical values for n = 15 or simply stated that the calculated value was higher than all the values in the table. Candidates should be aware that there are two types of tables, for identifying the critical value for Spearman's correlation. Sometimes the tables are given with the 'number of items' (n) and other versions have the entries listed by 'degrees of freedom' (df). Either can be assessed in the exams and candidates need to be careful when reading the heading in the tables. Many thought that if the calculated value was higher, it meant you should accept the null hypothesis. Exemplar 2  In this exemplar the candidate scored 2 marks. The candidate has correctly stated that the null hypothesis should be rejected and

					clearly understands that there is a 95% probability that the correlation is not due to chance. The candidate unfortunately missed the easy mark (scored by many less able candidates) by not comparing the calculated r_s value to the selected critical value. Also, the candidate did not state that the correlation is (statistically) significant which was a common omission. Very few candidates were able to state their explanations as clearly as this. **OCR support** Many candidates appear to find reporting conclusions from statistical tests very demanding. Support on the use of statistical tests and on probability and chance is available at: Maths for Biology website: Probability and chance Statistics for Biologists
	c		classification ✓ four / 4 ✓ Archaea ✓	3	**ALLOW** Archea / Archaebacteria **Examiner's Comments** Many candidates achieved one mark for 'classification' but only the most able candidates scored more than this. Candidates could be encouraged to read the whole paragraph first before trying to insert terms as they read through.
			Total	**8**	
5			D ✓	1	**Examiner's Comments** Most candidates selected the correct response, D. Some candidates selected answer C, possibly because the abbreviation of the full name is often used in texts. However, candidates should be aware that binomial names should be written in italics.

<table>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>6</td><td></td><td></td><td>A ✓</td><td>1</td><td><u>Examiner's Comments</u>

Most candidates selected the correct response, D. Some candidates selected answer C, possibly because the abbreviation of the full name is often used in texts. However, candidates should be aware that binomial names should be written in italics.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>7</td><td></td><td></td><td>A ✓</td><td>1
(AO2.1)</td><td><u>Examiner's Comments</u>

The vast majority of responses were correct, option A, The most common incorrect answers were C and B.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>8</td><td></td><td>i</td><td>(genetic) bottleneck ✓</td><td>1
(AO1.1)</td><td>ALLOW population bottleneck

<u>Examiner's Comments</u>

Most candidates correctly answered this question. Common incorrect answers included genetic drift or mass extinction.</td></tr>
<tr><td></td><td></td><td>ii</td><td><table><tr><th>Kakapo trait</th><th>Type of adaptation</th></tr><tr><td>Active at night to avoid predators</td><td>behaviour(al)</td></tr><tr><td>Green feathers that camouflage with its surroundings</td><td>anatomical</td></tr><tr><td>Slow digestion to extract nutrients from a high-fibre, low-protein diet</td><td>physiological</td></tr><tr><td>Strong beak and claws to climb trees</td><td>anatomical</td></tr></table>✓ ✓</td><td>2
(AO2.1)</td><td>2 correct = 1 mark
4 correct = 2 marks

ALLOW 'anatomy' for 'anatomical'

ALLOW 'physiology' for 'physiological'

ALLOW 'anatomy' for 'anatomical'

<u>Examiner's Comments</u>

This question was well answered with most candidates gaining at least 1 mark. A minority thought that green feathers, strong beak and claw were physiological adaptations</td></tr>
</table>

					and 'slow digestion' was anatomical adaptation.
		iii	*evidence for sympatric speciation* species live(d) in the same (geographical) area / AW ✓ ecological / behavioural / temporal , isolation ✓ (because) they occupy different , niches / AW ✓ *idea that* (some) kaka flew to North Island after speciation ✓ *evidence for allopatric speciation* geographical isolation as mountain range emerged / AW ✓ *idea that* (some) proto-kaka flew to the North Island and evolved into kaka / AW ✓ *idea that* (some) kaka later returned (to South Island) ✓	4 max (AO3.1) (AO3.2)	**ALLOW** ref to same location **IGNORE** ref to same / similar, environment / habitat **ALLOW** divergence / separation for isolation **IGNORE** reproductive / mechanical , isolation e.g. 'differences in diet' / 'time of activity' e.g. 'Alps creates physical barrier between populations' **Examiner's Comments** This was intended as a challenging question that required more than the standard descriptions of reproductive isolation, and few candidates were given full marks. Good answers linked the presence in the same geographical area and the differences in diets as evidence for the possibility of ecological or behavioral isolation, which can lead to sympatric speciation. Many answers also linked the emergence of the Southern Alps with possible geographical isolation, leading to allopatric speciation.
		iv	species richness is the number of (different) species (in an area or community or ecosystem) ✓ species evenness is the (relative) abundance (of individuals) in each species (in an area or community or ecosystem) ✓	2 (AO1.1)	**IGNORE** amount of different species (in an area or community or ecosystem) **ALLOW** 'species evenness is (a comparison of) the number (of individuals) in each species (in an area or community or ecosystem)' **Examiner's Comments** Many candidates had a good understanding of the difference between species richness and species evenness although less

					successful candidates' responses often lacked the precision required to gain both marks. For example, referring to 'amount' instead of 'number' when describing species richness, and the 'spread' or 'distribution' of a species rather than the relative abundance of each species, when describing species evenness.
			Total	**9**	
9			*idea that* that Archaea and Eukarya are (most closely) related due to similarities in, histones / (DNA) polymerase ✓ *idea that* Archaea and Bacteria are (most closely) related due to, similarities in ribosomes / absence of mitochondria ✓ no evidence that Bacteria and Eukarya are (most closely) related ✓ *idea that* helicase comparison provides no useful evidence ✓ *idea that* phylogeny / evolutionary relationships should be determined by genome analysis ✓	3 max (AO3.1) (AO3.2)	e.g. 'Archaea and Bacteria have similar organelles and are related' **ALLOW** ' Bacteria and Eukarya are least related because they only have helicase in common' **IGNORE** 'all contain the same helicase' unqualified **Examiner's Comments** Many candidates were able to score 2 marks for correctly stating that Archaea and bacteria could be closely related as well as Archaea and Eukarya, with evidence to support. Less successful responses stated the similarities but did not relate this to the question, and so could not be credited. Few candidates mentioned that bacteria and Eukarya were least related as they only have helicase in common, or that helicase comparison provided no useful evidence.
			Total	**3**	
10	a	i	(look larger) to, scare / deter, predators ✓ protection ✓	1 Max (AO1.1)	**IGNORE** attract mates / camouflage **Examiner's Comments** The photograph of a moth larva was a springboard for questions on adaptation, classification, natural selection in moths and convergent evolution in moles. This was well done, with most

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>candidates referring to protection or deterring predators.</td></tr>
<tr><td></td><td></td><td>ii</td><td><u>Uraba</u></td><td>1
(AO1.1)</td><td><u>Examiner’s Comments</u>

Most candidates correctly identified the genus name.</td></tr>
<tr><td></td><td></td><td>iii</td><td><table><tr><th>Taxonomic description</th><th>Hierarchical position</th></tr><tr><td>Phylum Arthropoda</td><td>2</td></tr><tr><td>Order Lepidoptera</td><td>4</td></tr><tr><td>Kingdom Animalia</td><td>1</td></tr><tr><td>Class Insecta</td><td>3</td></tr></table>✓</td><td>1
(AO2.1)</td><td><u>Examiner’s Comments</u>

Most candidates ordered the groups correctly in the taxonomic hierarchy.</td></tr>
<tr><td></td><td>b</td><td></td><td>1 (pale and) dark / colour difference, due to, genetic variation / (different) alleles / (random) mutation ✓

in, industrial / polluted / urban / lichen-free, area:
2 pale, selected against / eaten / less likely to survive OR dark, selected for / not eaten / more likely to survive ✓

3 (more) dark, reproduce / pass on <u>allele</u> / pass on mutation OR fewer / no, pale, reproduce / pass on their <u>allele</u> ✓

4 <u>frequency</u> of <u>allele</u> for, dark colour increases / pale colour decreases ✓</td><td>4
(AO1.2)
(AO2.1)</td><td>1 look for statement

ALLOW REVERSE ARGUMENTS
in, non-industrial / unpolluted / rural / lichen-rich, area:
2 pale, selected for / not eaten / more likely to survive OR dark, selected against / eaten / less likely to survive

3 (more) pale, reproduce / pass on their <u>allele</u> OR fewer / no, dark, reproduce / pass on <u>allele</u> / pass on mutation

4 <u>frequency</u> of <u>allele</u> for, pale colour increases / dark colour decreases

<u>Examiner’s Comments</u>

There were many less successful responses that reproduced sections of the introductory text without carefully extracting the key points about how natural selection operates to give the modern distribution of the two colour forms (phenotypes) of the peppered moth. When explaining how natural selection operates in any context, the points listed in the Assessment for learning box should be covered:</td></tr>
</table>

					Assessment for learning • explain that the different phenotypes arise due to **gene**tic variation, mutation in a **gene** or different alleles of a **gene** • give **one** environmental context when selection operates, e.g. in polluted, urban or industrial areas, **or** conversely in unpolluted or rural areas for this example • identify which phenotype is more likely to **survive** (has a selective advantage) in this context • relate a higher chance of surviving to a higher chance of **reproducing** or passing on the advantageous allele in this context • summarise how natural selection will affect the relative **frequency of the alleles** in the population, i.e. here the percentage frequency of the allele for the dark form increases at the expense of the allele for the pale form in an industrial or polluted location.
	c		**1** not closely related / no (recent) common ancestor / evolved separately, as, in different (named) families **OR** live / evolved, in different parts of the world ✓ **2** adapted / evolved, similarly / for same niche / for soil, as, both have / share, streamlined shape / modified fore limbs / velvety fur / diet of grubs and worms ✓	2 (AO1.2) (AO2.6)	**1 ALLOW** different (named), countries / continents for 'parts of the world' **2 ALLOW** developed to suit, same environment / same diet / soil, for 'adapted similarly' idea **Examiner's Comments** To explain how Fig. 6.3 supported the theory of convergent evolution candidates needed first to understand and explain the two **principles** of convergent evolution,

					that (i) the organisms are not closely related but that (ii) they show similarities because they have evolved separately to adapt to the same type of environment or lifestyle. Each principle could be supported by information from Fig. 6.3. The 'not closely related' idea could be supported either by reference to the two mole species living in separate parts of the world or to them being in separate families. The 'adapt to the same environment' idea could be supported by describing a feature they share that is useful in their soil habitat, such as modified fore limbs or streamlined shape. Few candidates had a secure understanding of these principles and were able to back them up with evidence from Fig. 6.3.
			Total	**9**	
11		i	1 horizontal axis labelled 'body length (mm)' **AND** vertical axis labelled , 'frequency' / 'frequency density' (/100 mm) ✓ 2 linear scale on both axes **AND** at least 50% of grid covered by plotted area ✓ 3 histogram plotted with ruled lines and touching bars ✓ 4 first 5 bars plotted accurately ± 0.5 squares and equal width ✓ 5 6th bar twice the width and height 23 ✓	5(AO3.3)	*Points 1 and 2 can be awarded for a line graph*. **1 ALLOW** unit written as '/ mm' **1** Unit for frequency density can be omitted. **4** Correct numbers: 10, 48, 121, 130, 119 (or 0.10, 0.48. 1.21, 1.30, 1.19 if frequency density used) **5** Height 0.23 if axis labelled 'frequency density' **Examiner's Comments** The full range of marks was seen for this question in which candidates had to draw a histogram to represent the data they had been given. The vast majority achieved the first marking point with very few reversing the axes, neglecting to label the axes or omitting units for body length. The second marking point was given to most of the answers seen but often candidates

					used a categoric scale on the *x*-axis or, occasionally, used a *y*-axis scale that did not fill enough of the available space. Some candidates did not achieve the third marking point because they had drawn a bar chart (where the bars didn't touch) rather than a histogram but almost all knew to use a ruler. Of the candidates who drew bars, most drew them the correct height; however, a few, usually those who had chosen an unusual *y*-axis scale (e.g., going up in 15s), did not manage to find 121 or 119. Very few got the final marking point, suggesting not much practice of histograms in lessons. It was noted that those few candidates who achieved all 5 marks tended to plot frequency density. **OCR support** Presentation of practical results is regularly assessed in examinations. Help in development of these skills can be found in the OCR Biology Practical Skills Handbook: Biology Practical Skills Handbook (ocr.org.uk)
		ii	bell-shaped / normal distribution ✓ (data / variation) continuous ✓	2(AO2.2)(AO3.2)	**ALLOW** most frequent values in middle of range **ALLOW** e.g., most common length is between 400 and 500 **Examiner's Comments** Around half of responses achieved a mark here for stating either that the variation was continuous or describing the shape of the curve, but very few candidates did both and hence both marks were rarely given. The first marking point was often given for a description of a bell-shaped curve; however, some potentially creditworthy descriptions ended up as attempts to support hypotheses about selection pressures and so were not given

					marks. **Misconception** A number of responses stated that the graph did not show a normal distribution but the shape of the graph in this question is about as close to a normal distribution as is likely to be achieved with real data of this type.
			Total	**7**	
12			C ✓	1(AO1.1)	
			Total	**1**	
13			D ✓	1(AO1.1)	**Examiner's Comments** Around a third of answers were correct; the most common response was C. It should be noted that, although cytochrome c is used for classification, cytochrome c is a protein and so it has an amino acid sequence, not a base sequence.
			Total	**1**	
14			**D** ✓	1	**Examiner's Comments** Only a minority of candidates gave the correct response (D). The most common incorrect responses were A and B. Candidates should appreciate that protein synthesis is one of the most fundamental requirements for life and therefore all organisms possess ribosomes.
			Total	**1**	