Neap

Final Examination 2021

NSW Year 11 Biology

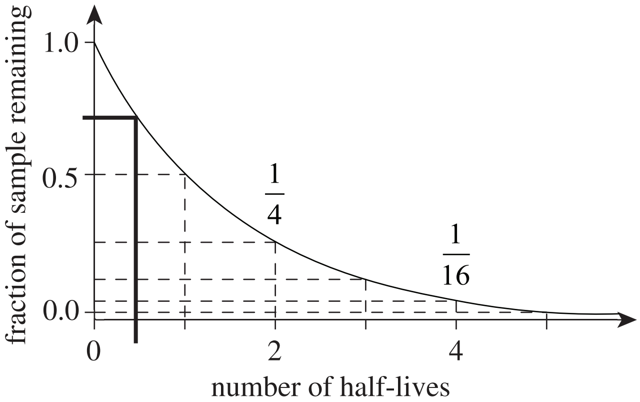
Solutions and marking guidelines

Section I

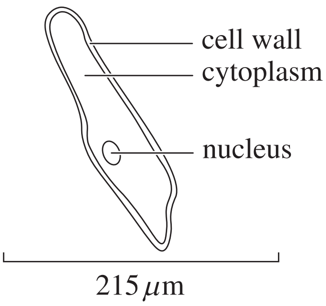
Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 1 **A** **A** is correct. Controlled variables must be kept constant to ensure a fair and valid test. The independent variable in this experiment is the pH so this variable must change. The dependent variable is the measured variable. In this case, the dependent variable is the time taken for the reaction to occur, which gives the scientist a measure of the rate of reaction $\left(\text{rate} = \frac{1}{\text{time}}\right)$. **B**, **C** and **D** are incorrect. The amount of lactase is another controlled variable, but pH and the time taken for the lactose to decompose are not.	Mod 1 Cells as the Basis of Life BIO11/12–3, 11–8 Band 3
Question 2 **A** **A** is correct. Mitochondria are characterised by their internal membranes, as pictured. They are usually long, cylindrical organelles. **B** is incorrect. The nucleolus would appear as a dark black dot in the nucleus. **C** is incorrect. A chloroplast would appear as a large organelle with stacks of internal membranes (grana). **D** is incorrect. The nucleus is a large circular organelle.	Mod 1 Cells as the Basis of Life BIO11/12–5, 11–8 Band 3
Question 3 **B** **B** is correct. The process that describes the movement of organic substances in the phloem tissue (translocation) is the pressure–flow mechanism. **A** is incorrect. The process is also known as source-to-sink, not sink-to-source. **C** is incorrect. The transpiration-cohesion-tension theory explains movement of water and inorganic substances in the xylem tissue. **D** is incorrect. There is no 'root-pressure mechanism'.	Mod 2 Organisation of Living Things BIO11–9 Band 3
Question 4 **C** **C** is correct. The image shown is a three-dimensional image of a microscopic tardigrade generated by a scanning electron microscope (SEM). **A** is incorrect. Monocular light microscope images, produced by light passing through a very thin specimen, are two-dimensional. **B** is incorrect. A binocular dissecting microscope would not have the magnification required to produce the image. **D** is incorrect. Transmission electron microscope images, produced by electrons passing through the specimen, are two-dimensional.	Mod 1 Cells as the Basis of Life BIO11/12–4, 11–8 Band 3

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 5 **A** **A** is correct. Urohydrosis is a behavioural adaptation of these birds. **B** is incorrect. While evaporative cooling is a physiological adaptation, the question asks about urohydrosis, which is a particular behaviour. **C** is incorrect. Structural adaptations refer to morphological features of an organism, such as long legs or feathers. **D** is incorrect. Biomimicry is the practice of learning from and mimicking strategies found in nature to solve human design challenges.	Mod 3 Biological Diversity BIO11–10 Band 3
Question 6 **B** **B** is correct. Convergent evolution occurs when distantly related organisms (in this case, a placental and a marsupial mammal) have very similar structures, which evolved as a result of being in similar environments. **A** is incorrect. Parallel evolution is the independent evolution of similar characteristics, developing from similar ancestors. **C** and **D** are incorrect. Divergent evolution, or adaptive radiation, occurs when organisms evolve from common ancestors and become different as a result of different environmental pressures.	Mod 4 Ecosystem Dynamics BIO11–10 Band 4
Question 7 **D** **D** is correct. There are more prey organisms than predators in a community. **A** is incorrect. There are not more predators than prey in a community. **B** is incorrect. There are more prey organisms than predators in a community. **C** is incorrect. While it is correct that there are fewer predators than prey in a community, the line labelled *B* does not represent the predators.	Mod 4 Ecosystem Dynamics BIO11–11 Band 1
Question 8 **C** **C** is correct. Endocytosis is movement of substances into a cell using vesicles created by the cell membrane. **A** is incorrect. The movement of substances from an area of high concentration to an area of low concentration is diffusion. **B** is incorrect. The movement of substances from an area of low concentration of solute to an area of high concentration of solute across a semi-permeable membrane is osmosis. **D** is incorrect. The movement of substances out of a cell using vesicles created by the cell membrane is exocytosis.	Mod 1 Cells as the Basis of Life BIO11–8 Band 3
Question 9 **A** **A** is correct. The grasshopper occupies the second trophic level and is a first-order consumer. **B** is incorrect. The grasshopper is a herbivore but it occupies the second trophic level. The first trophic level is occupied by the grass, as it is the producer. **C** is incorrect. The brown snake is the top carnivore, but it occupies the fourth trophic level in this food chain. **D** is incorrect. The grass is the producer, but the brown snake is not the only carnivore. The kingfisher is also a carnivore.	Mod 4 Ecosystem Dynamics BIO11/12–4, 11–11 Band 3

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 10 **A** **A** is correct. Consideration of the fossils and the rock layers shows that fossil 2 is the oldest fossil, as fossil 1 and fossil 3 appear in layers above fossil 2. This means that the mudstone layer under fossil 2 in column II is older than fossil 2 and the gneiss layer under that is older again. **B** is incorrect. Fossil 1 appears above both fossils 2 and 3. **C** is incorrect. The coal layer is below the siltstone layer, which means it was deposited before the limestone layer. **D** is incorrect. The best index fossils appear in a short time period. Fossil 3 appears in many layers.	Mod 3 Biological Diversity BIO11/12–4, 11/12–5, 11/12–6, 11–10 Band 5
Question 11 **B** **B** is correct. Australian plants such as species of *Banksia* and many eucalypts have evolved to survive in dry, warm environments. **A** and **C** are incorrect. These adaptations did not occur in response to increased rainfall or decreasing temperatures. **D** is incorrect. While serrated or spiky leaves can provide protection against predation, **B** is the better answer, as the question asks about adaptations for the environment, such as temperature and rainfall.	Mod 3 Biological Diversity BIO11/12–5, 11–10 Band 4
Question 12 **C** **C** is correct. The relationship is mutualism as both organisms benefit from the relationship. The ants receive nutrition by feeding on the nectar and the caterpillar gains protection from other organisms. **A** is incorrect. Parasitism is where one organism benefits and the other is harmed. **B** is incorrect. Commensalism is where one organism benefits and the other is neither harmed nor benefits from the relationship. **D** is incorrect. Amensalism is where one organism is harmed and the other organism remains unaffected.	Mod 4 Ecosystem Dynamics BIO11–11 Band 3
Question 13 **D** Surface area: $4 \times 4 \times 6 = 96$ Volume: $4 \times 4 \times 4 = 64$ Surface-area-to-volume ratio: $96 : 64 = 1.5 : 1$	Mod 1 Cells as the Basis of Life BIO11/12–6, 11–8 Band 5
Question 14 **C** **C** is correct. As blood goes to the muscles, it is high in glucose and oxygen. These compounds react in the mitochondria of the muscle cells during cellular respiration, producing carbon dioxide and water. The blood leaving the muscles will therefore be higher in carbon dioxide and lower in oxygen and glucose. **A**, **B** and **D** are incorrect. These options do not reflect the correct information about the changes to blood composition as it passes through the muscles. As muscle cells respire, they use up oxygen and glucose, and produce carbon dioxide and water.	Mod 2 Organisation of Living Things BIO11–9 Band 5

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 15 **A** **A** is correct. If the tuff layer has 25% argon, it means that the rock sample had 75% potassium. By drawing a line on the graph from 75% potassium (the fraction of the original sample) to the curve, then down to read the *x*-axis value, we see that the number of half-lives is just less than 0.5 of a half-life.  The half-life of potassium-40 is 1300 million years. Therefore, the value for the time lapsed is approximately $0.4 \times 1300 = 520$ million years. The tuff layer was below the sedimentary layer, where the trilobite was found, which means that the age of the sedimentary layer is younger than 520 million years. **B** is incorrect. 700 million years is older than half of one half-life. **C** and **D** are incorrect. These values are calculated based on incorrectly reading the graph at 25% potassium, which would give two half-lives.	Mod 3 Biological Diversity BIO11/12–4, 11/12–5, 11/12–6, 11–10 Band 6

Section II

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 16	
(a) The total magnification (×400) is the product of the ocular lens magnification (×10) and the objective lens magnification (x). $10 \times x = 400$ $x = \frac{400}{10}$ $= 40$ The objective lens magnification is thus ×40.	Mod 1 Cells as the Basis of Life BIO11/12–6, 11–8 Band 3 • Correctly calculates the magnification. 1
(b) (i) *Plant cell* 	Mod 1 Cells as the Basis of Life BIO11/12–6, 11–8 Bands 3–4 • Draws a clear biological diagram of the cell with all THREE of: – at least TWO correct labels – an appropriate heading – a correct scale . . . . 3 • Draws a clear biological diagram of the cell with any TWO of: – at least TWO correct labels – an appropriate heading – a correct scale . . . . 2 • Draws a clear biological diagram of the cell. 1
(ii) To estimate the length of the cell: Measure the length of the scale line (for example, 420 μm = 8.5 cm). Calculate the value for each centimetre $\left(\text{for example: } \frac{420}{8.5} = 49.4 \approx 50\ \mu\text{m}\right)$. Measure the length of the cell (for example, ≈ 4 cm). Multiply the length of the value for 1 cm in μm (for example, 4 × 50 μm). This provides an estimation of the length of cell X (for example, length of the cell ≈ 200 μm). *Note: Example calculations are not required but may help to establish a comprehensive response. Accept values that differ based on print sizes.*	Mod 1 Cells as the Basis of Life BIO11/12–4, 11–8 Band 4 • Explains in detail how to estimate cell size. AND • Shows an understanding of scale. . . . . 2 • Explains briefly how to estimate cell size. OR • Shows an understanding of scale. 1

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<table>
<tr><th>Sample answer</th><th>Syllabus content, outcomes, targeted performance bands and marking guide</th></tr>
<tr><td>(iii) The cells are most likely plant cells because they are rigid and rectangular in shape. Animal cells tend to be circular and irregular in shape. They are also large cells (200 μm), whereas animal cells tend to be much smaller than plant cells.</td><td>Mod 1 Cells as the Basis of Life
BIO11–8 Bands 2–3
• Correctly identifies the cell type.
AND
• Gives TWO valid reasons. 2
<hr>• Correctly identifies the cell type.
AND
• Gives ONE valid reason. . . . . 1</td></tr>
<tr><td>Question 17</td><td></td></tr>
<tr><td>(a)<table><tr><th></th><th>Independent variable</th><th>Dependent variable</th></tr><tr><td>Name of variable</td><td>concentration of sucrose</td><td>number of pulses (or pulsation)</td></tr><tr><td>Units for variable</td><td>mM</td><td>counts min^{-1}</td></tr></table></td><td>Mod 1 Cells as the Basis of Life
BIO11/12–2, 11/12–3, 11–8 Bands 2–3
• Correctly identifies the independent and dependent variables.
AND
• Correctly identifies the units.. 2
<hr>• Any ONE of the above points.. . . . 1</td></tr>
<tr><td>(b) As sucrose concentration increases, the number of pulses or bursts decreases.</td><td>Mod 1 Cells as the Basis of Life
BIO11/12–4, 11–8 Band 3
• Correctly states the trend of the graph.. . . . . 1</td></tr>
<tr><td>(c) Osmosis is movement of water from an area of low concentration of solute to an area of high concentration of solute across a semi-permeable membrane. The number of bursts from the contractile vacuole is dependent on the amount of water that enters the amoeba. When the concentration of the sucrose solution is low outside the cell, there will be a large concentration gradient between the outside solution and the internal cytoplasm of the amoeba. This will result in water flowing into the cell, because the cell has a higher concentration of sugars, or a higher osmotic pressure. Therefore, the number of expulsions from the cell will be high.

Conversely, when the concentration of sucrose outside the cell is higher than the concentration inside the cell, water will flow out of the cell; thus, the number of bursts will decrease.</td><td>Mod 1 Cells as the Basis of Life
BIO11/12–5, 11/12–6, 11/12–7, 11–8
Bands 5–6
• Defines osmosis.
AND
• Explains in detail why the number of bursts decreases as sucrose solution concentration increases.. 3
<hr>• Defines osmosis.
AND
• Gives a basic explanation of the trend of the graph. 2
<hr>• Defines osmosis.
OR
• Gives a basic explanation of the trend of the graph. . . . . 1</td></tr>
</table>

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 18	
For example: A prokaryotic cell has no membrane-bound organelles. An example of a prokaryote is a bacterial cell. A eukaryotic cell has membrane-bound organelles such as a nucleus and mitochondria. An example of a eukaryotic cell is an animal cell.	Mod 1 Cells as the Basis of Life BIO11–8 Bands 2–3 • Correctly identifies a difference between a prokaryotic and a eukaryotic cell. AND • Gives an example of a prokaryotic cell AND a eukaryotic cell. . . . . 2 • Correctly identifies a difference between a prokaryotic and a eukaryotic cell AND gives an example of a prokaryotic cell OR a eukaryotic cell. OR • Gives an example of a prokaryotic cell AND a eukaryotic cell. 1
Question 19	
For example: (see table below) *Note: A range of responses are acceptable.*	Mod 2 Organisation of Living Things BIO11–9 Band 3 • Completes the table with TWO valid examples. 1

Cell function	*Plant cell*	*Animal cell*
support	vessel element	osteocyte (bone cell)
transport	sieve tube	**red blood cell**
absorption	**root hair cell**	epithelial cells of the villi

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Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 20	
The structures involved in gaseous exchange in fish are the gills/lamellae. The structures involved in gaseous exchange in mammals are the lungs/alveoli. The structures involved in gaseous exchange in insects are the spiracles and tracheae. The function of the gaseous exchange surfaces in all three types of organisms is to facilitate entry of oxygen for cellular respiration into the animal and the diffusion of the carbon dioxide waste product of respiration out of the animal. *For example (similarities):* • The surfaces of the structures are moist. • The structures are highly vascularised (have a good supply of blood from capillaries – for fish and mammals – or a haemocoel – for insects). • Surfaces are thin to allow diffusion. • The structures have a large surface area. *For example (differences):* • Fish maintain a one-way flow of water across the gills and have a counter-current exchange system, which maximises diffusion of oxygen into the gills and carbon dioxide into the water. • In mammals, air goes in through the trachea and bronchi and oxygen diffuses into the blood through the alveoli. Carbon dioxide diffuses out of the blood into the lungs and goes out using the same pathway. • In insects, spiracles open into a system of tracheae, which bathes in a haemocoel (an open circulatory system). Gases diffuse in and out of the haemocoel from the tracheae.	Mod 2 Organisation of Living Things BIO11–9 Bands 2–6 • Identifies the gaseous exchange structures for EACH animal. AND • Outlines the function of respiratory surfaces. AND • Discusses in detail at least ONE difference and TWO similarities. OR • Discusses in detail at least TWO differences and ONE similarity. . . . . 5 • Identifies the gaseous exchange structures for EACH animal. AND • Outlines the function of respiratory surfaces. AND • Briefly outlines at least ONE difference and TWO similarities. OR • Briefly outlines at least TWO differences and ONE similarity. . . . . 4 • Identifies the gaseous exchange structures for EACH animal. AND • Outlines the function of respiratory surfaces. AND • Discusses at least ONE difference and ONE similarity. . . . 3 • Any TWO of the above points. . . . 2 • Any ONE of the above points.. . . . 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 21	
Haemoglobin is a protein used to improve the transport of oxygen around the body. Millions of haemoglobin molecules attach to red blood cells. Oxygen binds to haemoglobin according to the equation haemogloblin + oxygen $\rightleftharpoons$ oxyhaemoglobin. In very cold waters, oxygen concentration is higher (14 mg L^{-1}) than in temperate waters (8 mg L^{-1}). Because the concentration of oxygen is higher in cold waters, icefish can transport oxygen to their cells efficiently enough and survive without needing haemoglobin to boost their oxygen-carrying capacity like other fish from warmer waters.	Mod 2 Organisation of Living Things BIO11/12–5, 11/12–6, 11–9 Bands 5–6 • States the function of haemoglobin. AND • States that cold water has more oxygen than warm water. AND • Quotes relevant data from the graph. AND • States that icefish can survive without haemoglobin because there is more oxygen in their environment. . . . . 2 ——— • Any TWO of the above points. . . . 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 22	
For example: The rock pocket mouse is a small, light-brown mouse from the southwestern United States. On predominantly sandy desert soils, the brown mouse is camouflaged against predation by owls and other avian, reptilian and mammalian predators. In this sandy environment, the brown mouse is the dominant form in the population. After volcanic activity in the area, the lava flows cooled and changed the environment to dark basalt. Over time, the population evolved in response to this environmental change. This example of microevolution saw the populations in two different areas dominated by differently coloured mice – in the sandy desert, brown mice had the highest populations and on lava flows, the black mouse dominated. This can be explained using the main principles of Darwinism: • Variation: Inheritable variation exists within a population. The variation in the population of mice was evident in their colouring; some mice were brown and some had a genetic mutation that gave them dark-coloured fur on their backs. • Reproduction: More organisms are produced than will survive. The mice reproduced quickly and produced large numbers of offspring. • Struggle for survival: Offspring compete. The predators fed on rock pocket mice. The black mice were more easily seen on the sandy soil than the brown mice. However, having black fur was an advantage for mice who lived on the basalt lava flows. When the environment changed, so too did the allele frequency of the mouse population. The struggle for existence meant that the black mice (with the more favourable characteristics) survived to reproduce, passing their traits on to their offspring. • Survival of the most adapted: The population that lived on the lava flow changed, or evolved, to being predominantly black. *Note: A range of examples are acceptable. For example, platypus, horse, peppered moth and antibiotic or malaria resistance are appropriate.*	Mod 3 Biological Diversity BIO11/12–7, 11–10 Bands 2–6 • Outlines the evolution of a named organism. AND • Explains in detail the evolution of the named organism using the main principles of Darwinism, including that: – inheritable variation exists within a population – more organisms will be produced than will survive – there is a struggle for survival or competition for resources – the most adapted organism will survive to reproduce and the population will change to become predominantly like the more adapted organism . . . . 5 • Outlines the evolution of a named organism AND briefly explains the evolution of the named organism using any THREE of the main principles of Darwinism listed above. OR • Explains in detail the evolution of organisms in general using ALL of the main principles of Darwinism listed above without referring specifically to a named organism. 4

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 22 (continued)	
	• Outlines the evolution of a named organism AND outlines the evolution of the named organism using any TWO of the main principles of Darwinism listed above. OR • Explains in detail the evolution of organisms in general using any THREE of the main principles of Darwinism listed above without referring specifically to a named organism. 3
	• Outlines the evolution of a named organism AND shows limited understanding of the main principles of Darwinism. OR • Briefly explains the evolution of organisms in general using any TWO of the main principles of Darwinism listed above without referring specifically to a named organism. 2
	• Engages with the question AND names an organism AND shows some understanding of the evolutionary process. OR • Shows a basic understanding of the evolutionary process. 1

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Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 23	
Palaeontology is the study of fossils. Fossils are any evidence of past life. Examples include casts, moulds, footprints, coprolites, shells and bones. Geology includes the study of rock layers. The law of superposition dictates that layers deposited first on the Earth are below subsequent, younger layers of the Earth. This principle allows scientists to assume fossils found in deep layers are older than fossils found closer to the surface. Radioisotopes are radioactive elements that decay at a regular rate, undergoing transmutation into other elements. This rate of decay can be accurately measured. Rocks containing radioisotopes can be analysed using mass spectrometers to compare ratios of parent elements and daughter nuclei so the age of the rock can be estimated. An example used for aging rocks is potassium/argon dating. Organic material such as bone can be dated using carbon-14, which transmutates into nitrogen-14. When fossils, geology and radioisotopic dating are used together, they can provide evidence for the change in organisms over time on our planet. For example, there are lots of fossils from ancient coral reefs around Molong and Borenore in central-western New South Wales. If trilobite or crinoid fossils from an ancient Silurian reef are found in a limestone layer, it shows that crinoids, trilobites and corals once existed. If rock layers above and below those layers can be dated (by volcanic rock containing radioisotopes, such as tuff layers), then an estimate of the age of those reef fossils can be made. Scientists will compare similar older and younger fossils and notice changes in those species over time. Changes in species over time is evolution, so this is an example of how palaeontology, geology and radioisotopic dating provide evidence for evolution.	Mod 3 Biological Diversity BIO11/12–7, 11–10 Bands 2–6 • Describes palaeontology AND geology AND radioisotopic dating. AND • Describes how each provides evidence for evolution. AND • Gives named examples of fossils AND isotopes. AND • Shows an understanding of evolution as a change in a species over time. . . . . 5 • Any THREE of the points above in detail. OR • All FOUR of the points above, but only refers to TWO of paleontology, geology or radioisotopic dating. . . . . 4 • Any THREE of the points above. OR • Briefly discusses palaeontology AND geology AND radioisotopic dating.. . . . . . . 3 • Any TWO of the points above. OR • Shows some knowledge of TWO of palaeontology, geology or radioisotopes.. . . . . 2 • Any ONE of the points above. OR • Shows some understanding of how palaeontology, geology OR radioisotopic dating provide evidence for evolution. 1

	Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 24		
(a)	Bat coronavirus RaTG13 is most closely related to the SARS-CoV-2 virus. *Note: Reading a phylogenetic tree is assumed knowledge. Branches on the left-hand side of the diagram indicate early mutations/changes and more distant relatives. Branches further on the right indicate close relatedness, like other evolutionary phylogenetic trees.*	Mod 3 Biological Diversity BIO11/12–4, 11/12–5, 11–10 Band 4 • Identifies the correct virus 1
(b)	*Any one of the following:* • Human coronavirus HKU1 • Murine hepatitis virus • Human coronavirus OC43 • Pipistrellus bat coronavirus HKU5 • Tylonycteris bat coronavirus HKU4 • MERS-CoV *Note: All listed viruses are embecoviruses or merbecoviruses, which branched off earliest in the phylogenetic tree and so are most distantly related to the human SARS-CoV-2 strain.*	Mod 3 Biological Diversity BIO11/12–4, 11/12–5, 11–10 Band 4 • Identifies a correct virus 1
Question 25		
(a)	The six shaded quadrats, from left to right and moving down the image: $2+3+3+0+1+4=13$ $\frac{13}{6}=2.17$ per m^2 total area of forest: $6\times5=30$ m^2 total population in forest: $30\times2.17=65$ trees	Mod 4 Ecosystem Dynamics BIO11/12–3, 11/12–4, 11–11 Bands 3–4 • Correctly estimates the population of trees using the quadrat sampling technique. AND • Shows correct working . . . . 2 --- • Correctly estimates the population of trees without showing working. OR • Shows correct working without the correct estimate. 1
(b)	*Any one of:* • Repeat the estimation and take the average of the estimates (to ensure no counting errors have been made). • Repeat the estimation using six different randomly selected quadrats and take the average of both estimates.	Mod 4 Ecosystem Dynamics BIO11/12–2, 11/12–3, 11–11 Bands 3–4 • Correctly identifies a way to improve the reliability of the estimate 1

Sample answer		Syllabus content, outcomes, targeted performance bands and marking guide
(c)	Animals are mobile; therefore, setting stationary quadrats will not be satisfactory for estimating populations of most large, fast-moving animals because the animals move through different quadrat boundaries and the count will be inaccurate. Some small animals like limpets, or slow-moving animals like snails, can be estimated using quadrats because they have a small range and will not move out of the quadrats while the estimate is being conducted. Sometimes animals can be harmed if quadrat sampling removes animals from their natural environment (for example, collecting animals from a quadrat in the field and counting organisms back in a laboratory).	Mod 4 Ecosystem Dynamics BIO11/12–2, 11/12–3, 11–11 Bands 4–5 • Makes a judgement of value. AND • Explains that quadrat sampling is not an appropriate estimation tool for animals that are fast moving or have large ranges. AND • Explains that quadrat sampling is an appropriate estimation tool for animals that have small ranges or are slow moving. OR • Acknowledges the quadrat sampling technique may harm animals in some way 3
		• Any TWO of the above points. . . . 2
		• Any ONE of the above points 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 26	
Rock paintings can provide information about past environments. The rock painting at Ubirr tells us that thylacines once existed in the Northern Territory, despite thylacines only existing in Tasmania when Europeans first came to Australia. Representations of Tasmanian devils, thylacines and other extinct organisms such as *Thylacaleo carnifex*, the marsupial lion, have been depicted in rock art throughout Australia. By dating the pigments or surrounding materials (like wasp nests), scientists can estimate the age of the rock paintings. This information, coupled with analysis of the artworks, can provide information about the flora and fauna that once existed in those particular areas of Australia. Shell middens (piles of shells, otoliths and bones left from occupation sites) can also be dated and analysed to provide information about ancient fauna. By comparing modern-day organisms and environments with evidence from ancient middens, scientists can learn valuable information about the species that inhabited certain environments and draw conclusions of how environments have changed over time. An example of this is Lake Mungo, where evidence of fish, shellfish, yabbies and mammals suggests that the environment 50 000 years ago was very different from the present semi-desert environment.	Mod 4 Ecosystem Dynamics BIO11/12–7, 11–11 Bands 2–5 • Provides a detailed discussion. AND • Refers to the rock painting at Ubirr OR another suitable example. . . . . 3 • Provides a suitable discussion. AND • Refers to the rock painting at Ubirr OR another suitable example. . . . . 2 • Provides a suitable discussion. OR • Refers to the rock painting at Ubirr OR another suitable example. 1
Question 27	
(a) A stomate is a structure on the surface of a leaf that allows the passage of carbon dioxide and oxygen (for the metabolic reactions of photosynthesis and respiration), and water vapour (transpiration stream). The stomates open and close to allow for the diffusion of gases and to regulate water loss (transpiration) from the plant.	Mod 2 Organisation of Living Things BIO11–9 Bands 2–3 • Explains the function of the stomate in terms of gaseous exchange AND control of water loss. . . . . . . 2 • Explains the function of the stomate in terms of gaseous exchange OR control of water loss. 1

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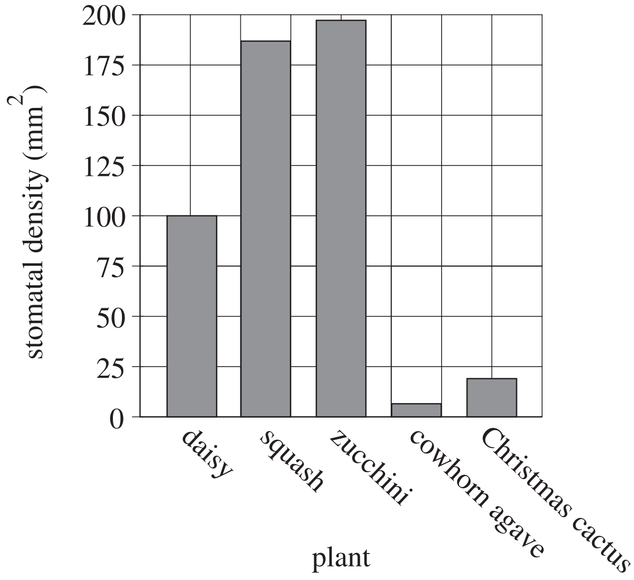
Sample answer	**Syllabus content, outcomes, targeted performance bands and marking guide**
(b) *Stomatal density of plants*  	Mod 3 Biological Diversity BIO11/12–7, 11–10 Bands 2–5 • Includes an appropriate title. AND • Draws a column graph. AND • Correctly plots columns. AND • Correctly labels axes AND includes units. AND • Uses an appropriate scale. . . . . 3 • Any FOUR of the above points. . . 2 • Any TWO or THREE of the above points. 1

	Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(c)	The cowhorn agave (*Agave bovicornuta*) and the Christmas cactus (*Schlumbergera russelliana*) are the desert plants. These two plants have a stomatal density significantly lower than the other plants (8 and 17 mm^2 respectively). A lower stomatal density means that there are fewer pores to allow the transpiration of water from the plant. Deserts have high temperatures and low rainfall, so the environment is very dry. Desert plants need adaptations to minimise water loss. Therefore, lower stomatal density would make these two plants adapted to a dry desert environment. Plants that do not live in the desert and live in environments with higher rainfall will have higher stomatal density, as they do not need to conserve water. The daisy, squash and zucchini plants would be from areas with soil that has higher water availability.	Mod 3 Biological Diversity BIO11/12–4, 11/12–5, 11/12–6, 11–10 Bands 4–6 • Correctly identifies the desert plants. AND • Identifies that deserts are environments with lower rainfall and/or higher temperatures. AND • States that lower stomatal density will result in lower transpiration rates or water loss. 3 • Correctly identifies the desert plants AND identifies that deserts are environments with lower rainfall and/or higher temperatures. OR • Correctly identifies the desert plants AND states that lower stomatal density will result in lower transpiration rates or water loss. . . . . 2 • Correctly identifies the desert plants. OR • Identifies that deserts are environments with lower rainfall and/or higher temperatures. OR • States that lower stomatal density will result in lower transpiration rates or water loss. 1

		Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(d)	(i)	*Any one of:* • Carbon dioxide (CO_2) is used for photosynthesis. If there is a high concentration of CO_2 in the air, plants can obtain plenty of CO_2 from the air around the leaf and do not need as many stomates to increase diffusion rates of the gas. • When CO_2 levels are high, the air temperature is higher. Therefore, the rate of transpiration is higher. Plants may have reduced numbers of stomates to reduce the rate of transpiration.	Mod 3 Biological Diversity BIO11/12–4, 11/12–5, 11/12–6, 11–10 Band 4 • Provides a suitably detailed explanation. . . . . 2 • Shows some understanding of the relationship. 1
	(ii)	CO_2 is a greenhouse gas. Increased CO_2 levels increase average global temperature. By studying ancient plants like gingkoes and analysing stomatal density, scientists can draw conclusions about past climates. For example, we can measure the stomatal density of a plant growing in a specific concentration of CO_2, as per the Smithsonian research project. If we count the stomatal density from ancient gingko fossils, we can compare that density to the leaves growing on present-day plants in particular CO_2 environments. By matching the stomatal densities from ancient gingkoes with those grown in the specific experimental environments, conclusions can be made about the CO_2 levels when the fossil gingkoes were alive. If CO_2 levels were higher in the past, for example in the Jurassic period, then we can also conclude that the global temperature was warmer at that time.	Mod 3 Biological Diversity BIO11/12–4, 11/12–5, 11/12–6, 11–10 Bands 4–6 • States that the comparisons allow scientists to draw conclusions about past CO_2 concentrations. AND • Shows an understanding of the relationship. . . . . 2 • Any ONE of the above points.. . . . 1

	Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(iii)	Future ecosystems are under threat from several human impacts. The loss of biodiversity on the planet is significant. We can use the study of past environments and past extinction events to understand pressures on populations, such as climate change. By using models, we can predict the effects of changes to environments and then be proactive to avoid catastrophic events that will negatively impact biodiversity. Animals such as the mountain pigmy possum are threatened because global temperatures are rising. If we can prevent further global warming, perhaps the pigmy possum will avoid extinction. Another example is the management of introduced species. We can learn lessons from the introduction of the rabbit and cane toad and prevent future disasters by limiting introduction of exotic species. Australia's biosecurity is one of the strictest in the world, as we have learnt from mistakes in the past. Border security protects and preserves our ecosystems by limiting the introduction of diseases, exotic plants and invasive animal species that can wreak havoc on our unique environments.	Mod 3 Biological Diversity BIO11/12–7, 11–11 Bands 4–6 • Provides a detailed discussion. AND • Uses TWO examples. . . . . 3 — • Provides a detailed discussion. AND • Uses ONE example . . . . 2 — • Provides a relevant outline. 1