

Name

Teacher

NORTH SYDNEY GIRLS HIGH SCHOOL



Year 11 2023

Assessment Task 3

BIOLOGY

General Instructions

- Reading Time – 5 minutes
- Working Time – 2 hours
- Write using blue or black pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- Write your name and your teacher's name at the top of this booklet and the Multiple Choice Answer Sheet

Total marks – 70

Weighting – 40%

Section I 20 Marks

- Attempt Questions 1 – 20
- Allow about 35 minutes for this section
- Record your answer on the Multiple Choice Answer Sheet

Section II 50 Marks

- Attempt Questions 21 – 28
- Allow about 1 hour and 25 minutes for this section
- Write your answers in the space provided

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Use the multiple-choice answer sheet provided for Questions 1-20.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9

A ☐ B ☒ C ☐ D ☐

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

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correct

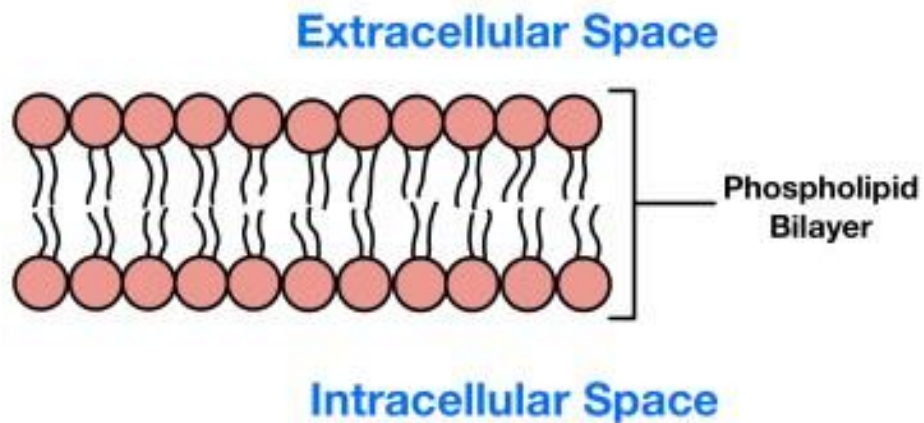
1. The cleaner wrasse is a type of fish that lives by picking and eating parasites from the gills of large reef fish. Occasionally, a cleaner wrasse will bite off and eat gill tissue from its host which causes harm to the fish but is not fatal.



This represents a change from

- A. commensalism to predation.
 - B. mutualism to predation.
 - C. commensalism to parasitism.
 - D. mutualism to parasitism.
-
2. Which flowchart correctly identifies the pathway that food travels through the human digestive system?
 - A. Oesophagus → stomach → large intestine → small intestine → rectum
 - B. Oesophagus → stomach → small intestine → large intestine → rectum
 - C. Oesophagus → stomach → pancreas → small intestine → large intestine
 - D. Trachea → stomach → large intestine → small intestine → rectum

3. The diagram below shows the phospholipid bilayer of a cell membrane.



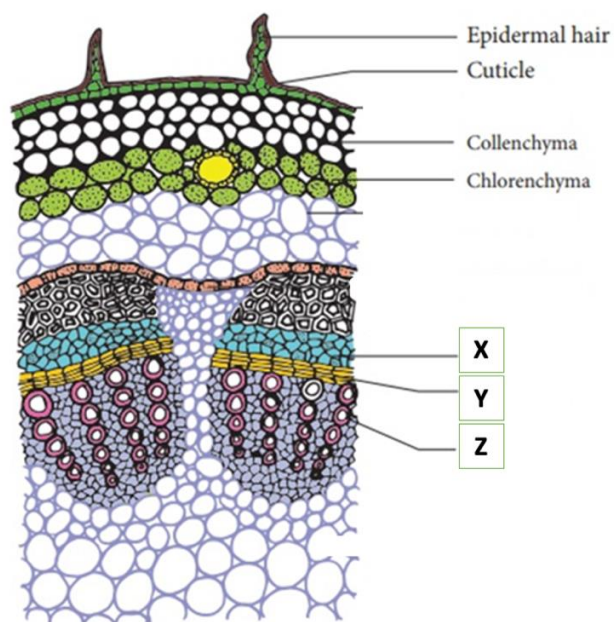
Which of the following correctly describes the arrangement of phospholipids in this diagram?

- A. Hydrophilic lipid heads are on the outside; hydrophobic phosphate tails are pointing in towards each other.
 - B. Hydrophilic phosphate heads are on the outside; hydrophobic lipid tails are pointing in towards each other.
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4. Mangroves are Australian plants that have several adaptations that allow them to thrive in saline tidal waters. One adaptation is that the mangrove can excrete salt through glands on their leaves.

According to this information, what type of adaptation could this be best classified as?

- A. Structural
- B. Behavioural
- C. Physiological
- D. Chemical

5. The diagram below shows a cross section of a dicot plant stem.



Which of the following correctly identifies X, Y and Z?

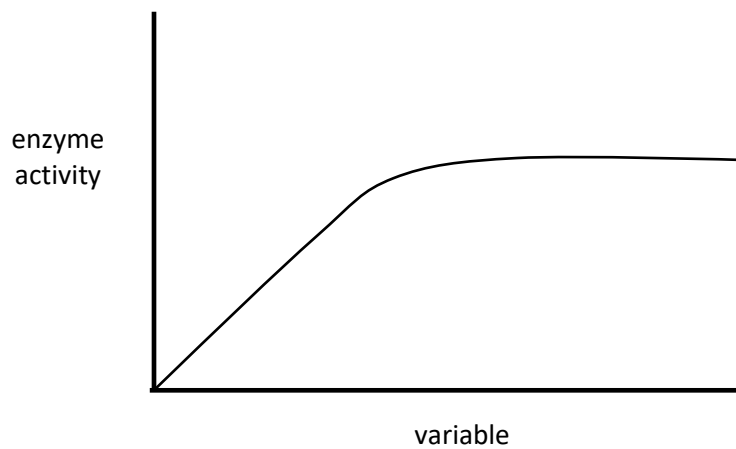
	X	Y	Z
A.	Xylem	Phloem	Cambium
B.	Xylem	Cambium	Phloem
C.	Phloem	Xylem	Cambium
D.	Phloem	Cambium	Xylem

6. *Chlamydomonas reinhardtii* is a unicellular organism that is motile (capable of moving). The cell is oval shaped and has a length of 10 μm and a width of 3 μm . It has a cell wall, two flagella and two contractile vacuoles near the bases of the flagella. The cell contains a chloroplast, a nucleus and an eyespot.

C. reinhardtii can be classified as

- A. an autotrophic prokaryote.
- B. a heterotrophic prokaryote.
- C. an autotrophic eukaryote.
- D. a heterotrophic eukaryote.

7. The graph below shows the effect of an unknown variable on enzyme activity.



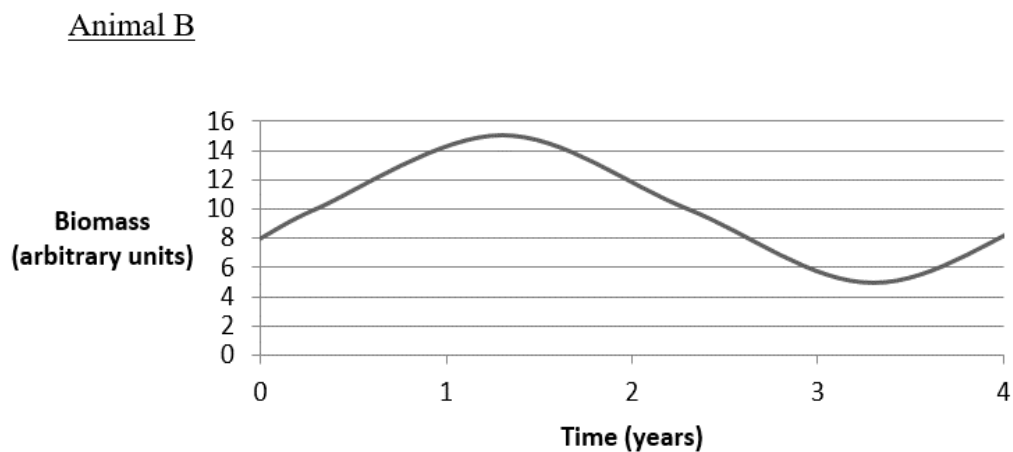
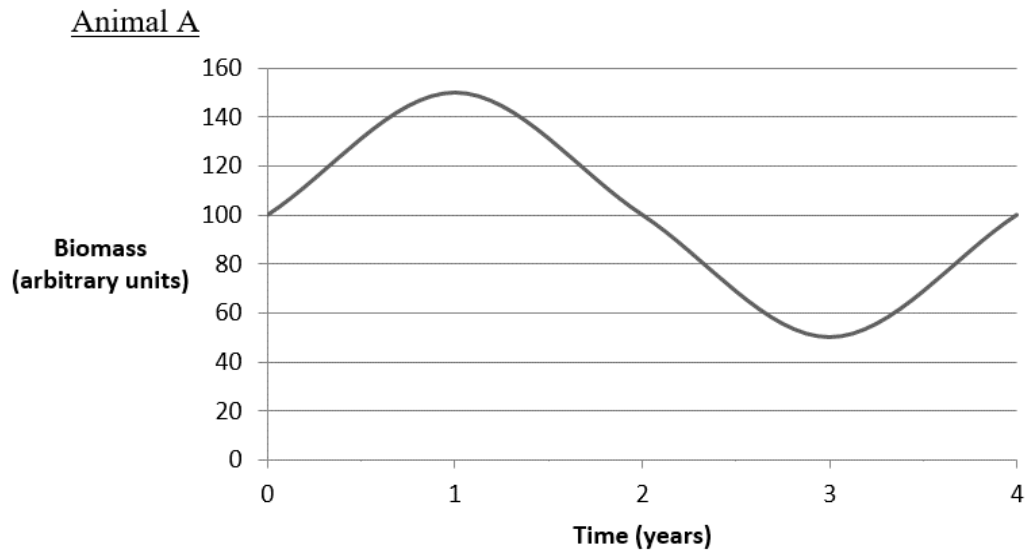
Which of the following variables is this most likely to be?

- A. Temperature
 - B. pH
 - C. Volume
 - D. Substrate concentration
8. Many Eucalypt species are well adapted to live in hot, dry climates in Australia. Their pale green leaves hang vertically and have reduced stomatal density.

What is the reason for these adaptations?

- A. To conserve water
- B. To increase the rate of transpiration
- C. To increase the rate of photosynthesis
- D. All the above

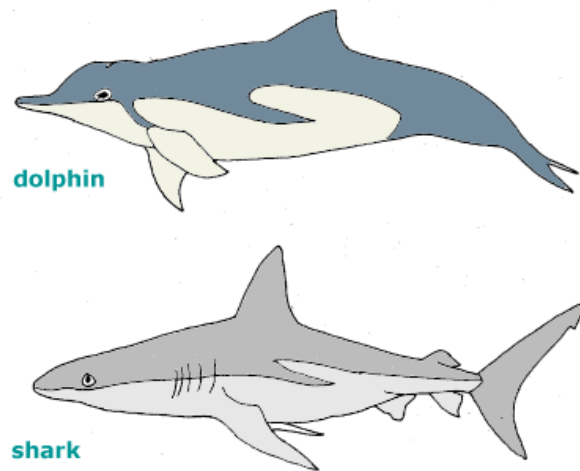
9. The graphs below show how the populations (represented as biomass) of two species of animal varied in a particular ecosystem over four years.



Which of the following ecological relationships do these graphs most likely represent?

- A. Competition between Animal A and Animal B for a common resource
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- C. A predator/prey relationship where Animal A is the predator and Animal B is the prey
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10. Sharks and dolphins occupy similar marine environments. Sharks are cartilaginous fish and dolphins are mammals, and the animals share many common characteristics as can be seen in the diagram below.



Sharks and dolphins are an example of convergent evolution because they

- A. have similar environmental pressures that select similar traits such as streamlined bodies and a grey colour.
 - B. occupy different niches within similar environments, so they have developed different feeding strategies.
 - C. share a common ancestor, so they show very similar traits.
 - D. share the same DNA because they interbreed, so they show very similar traits.
11. Why is chewing food with your teeth an important part of the digestive process?
- A. Chewing decreases surface area of food for the action of digestive enzymes
 - B. Chewing increases surface area of food for the action of digestive enzymes
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12. Areas around disused copper mines are often found to have soils high in copper ions. The plants growing in these areas are frequently distinct varieties of plants common to the general area. In a research study investigating the distribution of tolerant and sensitive plants on a mine site, seeds from adult plants of one species were collected from a population close to the mine and a population four kilometres from the mine site. The seeds were grown in a laboratory under identical conditions and tested for tolerance to copper ions in their soil. Adult plants were also surveyed in these two locations.

The results are shown in the table below.

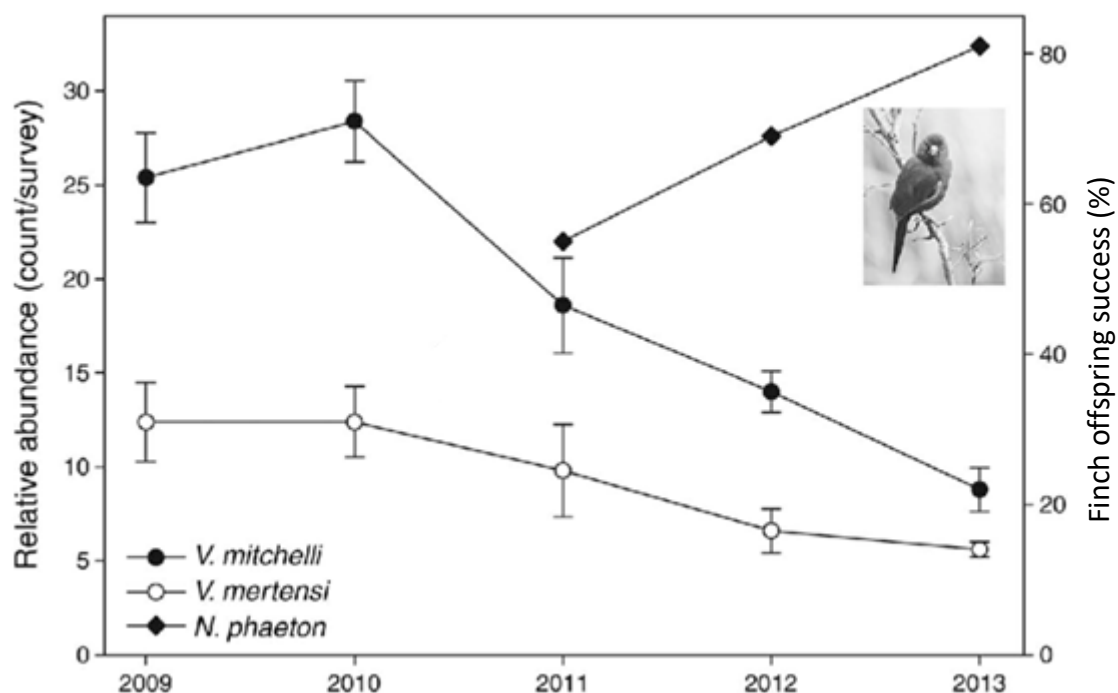
Factor	Mine site	Field 4 km away from mine site
Adult plant	All tolerant	All sensitive
Offspring grown from seed	Most tolerant, some sensitive	Most sensitive, some tolerant

What can be concluded from these results?

- A. Copper ions in the soil cause mutations which aid survival.
- B. Natural selection removed the tolerance gene from the population 4 km away from the mine site.
- C. Natural selection removed the sensitive gene from the population at the mine site.
- D. Copper ions acted as a selection pressure favouring some individuals.

Use the following information to answer Questions 13 – 14

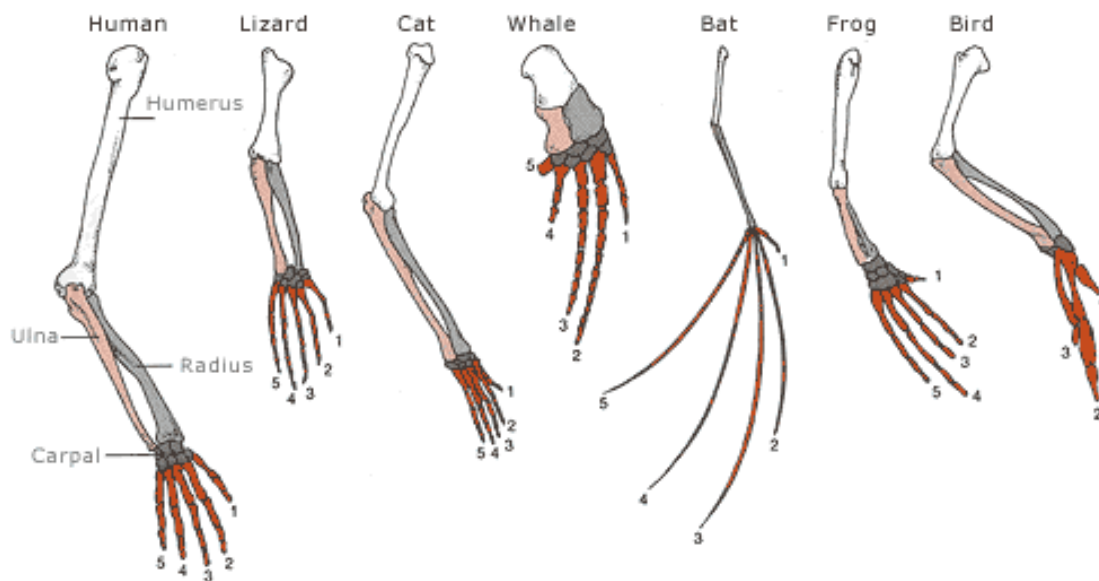
The graph below shows the impact on the population size of two species of monitor lizards *Varanus mitchelli* and *Varanus mertensi* (abundance on left y-axis) and a species of finch *Neochmia phaeton* (offspring success on right y-axis) after the introduction of cane toads into their habitat. Cane toads often lead to the death of predator species when ingested due to the toxin secreted by the toad.



13. The cane toad was most likely introduced in what year?

- A. 2009
- B. 2010
- C. 2011
- D. 2012

14. Which statement is most accurate when describing the impact of cane toads on the monitor lizard and finch populations?
- A. The monitor lizard *V. mitchelli* has the greatest decline in relative abundance, while the finch offspring success increased at a constant rate.
 - B. The monitor lizard *V. mitchelli* has the greatest decline in relative abundance, while the finch offspring success increased at an increasing rate.
 - C. The monitor lizard *V. mertensi* has the greatest decline in relative abundance, while the finch offspring success increased at a constant rate.
 - D. The monitor lizard *V. mertensi* has the greatest decline in relative abundance, while the finch offspring success increased at an increasing rate.
15. The diagram below shows the forelimbs of seven different vertebrate species, each of which have five digits, as well as other similarities in their structure.



An analysis of these forelimbs shows that they

- A. evolved from a common ancestor.
- B. adapted to similar environments.
- C. all belong to the same class.
- D. use the pentadactyl limb for the same function.

Use the following information to answer Questions 16 – 17

A student conducted an experiment to determine how certain variables affect the rate of transpiration. She took four cuttings of a plant and set up her experiment in four identical test tubes under the conditions outlined in the table below.

Test tube	Air temperature (°C)	Wind speed (km hr ⁻¹)	Humidity (%)
A	10	0	75
B	15	10	50
C	10	15	25
D	15	10	0

16. Which test tube would retain the most water after they have all been exposed to these conditions for the same amount of time?

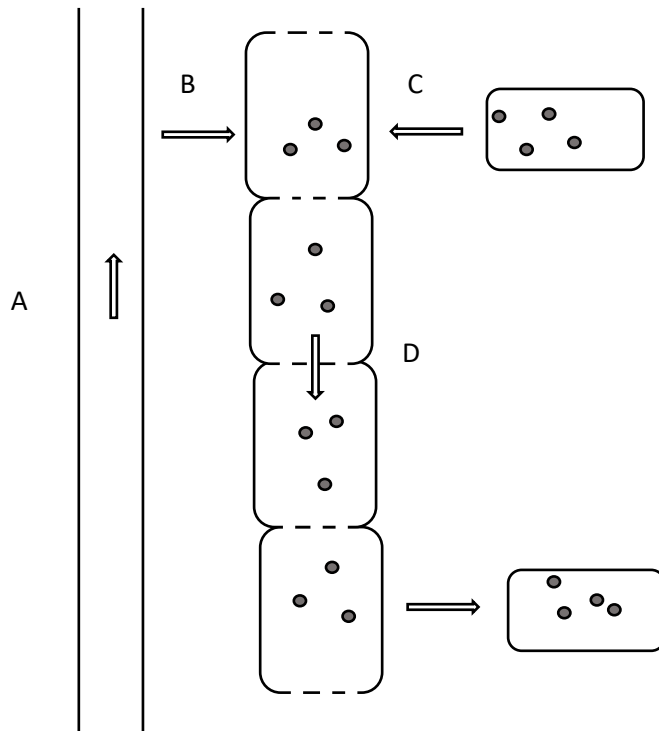
- A. A
- B. B
- C. C
- D. D

17. Which pair of test tubes would you need to compare to show the effect of humidity on transpiration?

- A. A and B
- B. B and C
- C. B and D
- D. C and D

Use the following information to answer Questions 18 – 19

The diagram below shows the movement of substances through plant vascular tissue.



18. Which arrow represents a process which uses active transport?

- A. A
- B. B
- C. C
- D. D

19. What is the substance whose movement is represented by the arrow at B?

- A. Sucrose
- B. Starch
- C. Chlorophyll
- D. Water

20. A student was studying four unlabelled cell samples. She identified and counted some organelles in each cell sample and recorded her results in the table below.

Cell sample	Number of chloroplasts	Number of mitochondria
1	0	30,000
2	0	5,000
3	0	450
4	60	300

Which of the following could be true of the cell samples?

- A. Cell sample 1 is a red blood cell.
- B. Cell sample 4 is a prokaryotic cell.
- C. Cell sample 3 is a mesophyll cell.
- D. Cell samples 3 and 4 are plant cells.

END OF SECTION I

Section II 50 marks

Attempt questions 21 – 28

Allow about 1 hour and 25 minutes for this section

Please write all answers clearly in the spaces provided. The number of lines indicates the expected length of your response.

Question 21 (4 marks)

Complete the table below by writing **increase** or **decrease** in each box to indicate how the blood composition changes as it moves through the organs listed.

Organ or tissue	Changes in concentration of the component in blood		
	Oxygen	Carbon dioxide	Glucose
Heart			
Lungs			
Small intestine			
Muscle			

Question 22 (3 marks)

Compare and contrast arteries, veins and capillaries by completing the table below.

Vessel Type	Similarity	Difference
Artery		
Vein		
Capillary		

Question 23 (3 marks)

Diabetes is a disease in which the body is unable to regulate blood sugar levels. Individuals with diabetes often have elevated levels of glucose in their blood because the hormones required to maintain regular glucose levels are not produced or do not function effectively. A high concentration of sugars in the blood can dehydrate the body cells.

Explain why a high blood glucose concentration can cause dehydration in the body's cells.

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Question 24 (4 marks)

Pulmonary emphysema is a lung condition characterized by the enlargement of the alveoli in the lungs. The alveoli increase in size as the alveolar walls break down, decreasing the surface area of functional lung tissue. Pulmonary emphysema usually affects the middle aged or older population because it takes time to develop with the effects of tobacco smoking or vaping, although a genetic risk factor may lead to the condition presenting earlier. Symptoms include breathlessness and feeling fatigued.



Explain how emphysema leads to these symptoms.

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Question 25 (8 marks)

On 26th April 1986, the worst nuclear accident in history occurred when a reactor in the Chernobyl Nuclear Power Plant exploded and burned. Massive quantities of radioactive material were emitted from the plant and residents were evacuated from the area. A 4,000 km² exclusion zone was established around the plant and is still in place today.

Despite the dangerously high levels of radiation in the exclusion zone of Chernobyl, many pet dogs survived and reproduced. The descendants of these dogs are of huge interest to scientists due to their survival in the face of extraordinary levels of radiation.

From 2017-2019, a team of scientists carried out an investigation into a group of dogs that lived at the base of the Chernobyl Nuclear Power Plant and hence experienced the highest radiation levels in the area. Blood samples were taken from the animals and genetic analysis was done to compare the genes of these dogs with dogs living in a town called Slavutych (30 km away from the plant). The results showed that the dogs living at the base of the Chernobyl Nuclear Power Plant were genetically different from the dogs living in Slavutych.

- a) Using your knowledge of Evolution by Natural Selection, explain how the Chernobyl dogs became genetically different to the Slavutych dogs.

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b) After many generations, it is possible for speciation to occur in the dog population in Chernobyl. Explain how this might eventuate.

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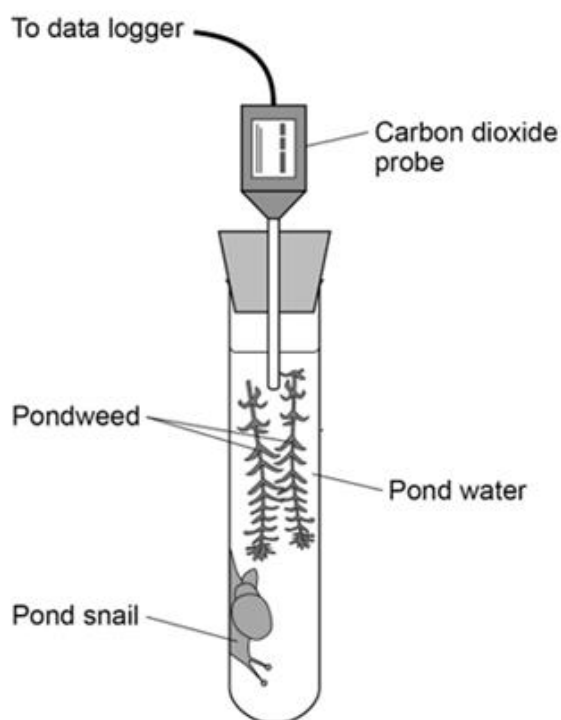
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Question 26 (14 marks)

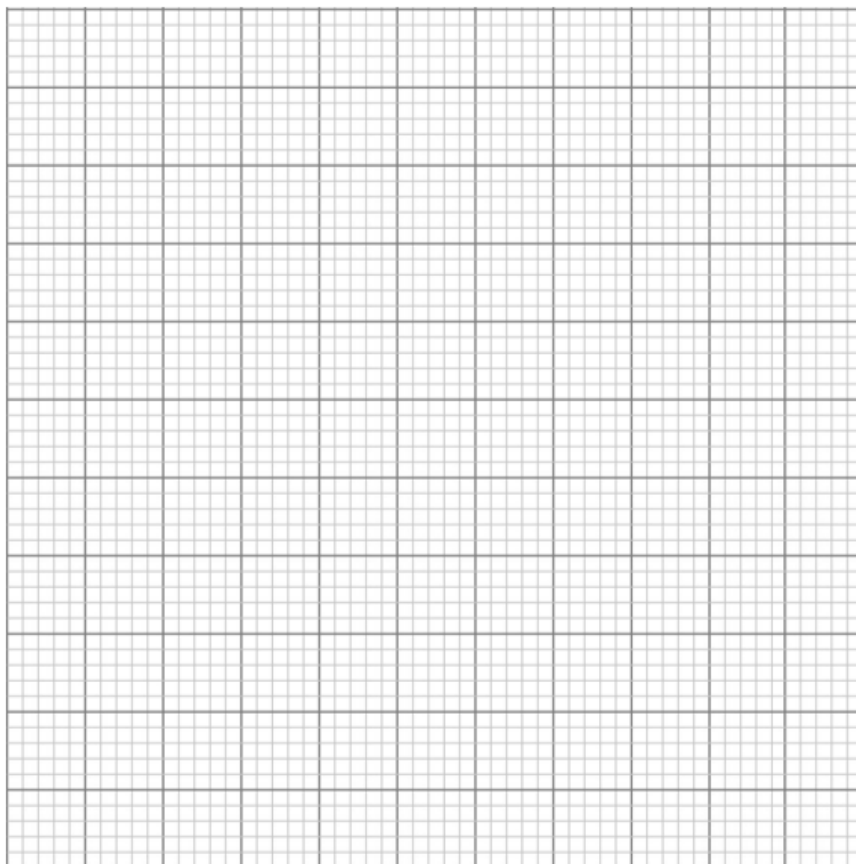
A scientist was investigating respiration and photosynthesis using some pondweed and a pond snail. The diagram below shows the apparatus used.



The data logger recorded the concentration of carbon dioxide continuously throughout a 10 day period. The results are shown in the table below.

Time (days)	Concentration of carbon dioxide (ppm)
0	381
2	381
3	381
5	411
7	455
9	522
10	599

- a) Construct a graph for the data in the table. Include an appropriate line of best fit. **4**



- b) Describe the trend in the graph. **3**

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QUESTION 26 CONTINUES ON NEXT PAGE

c) On Day 4, the scientist completely covered the test tube with black paper.

Explain how this accounts for the shape of the graph.

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d) At the conclusion of her experiment, the scientist discovered that the pond weed and snail had died. Using your knowledge of cellular respiration, explain why this occurred.

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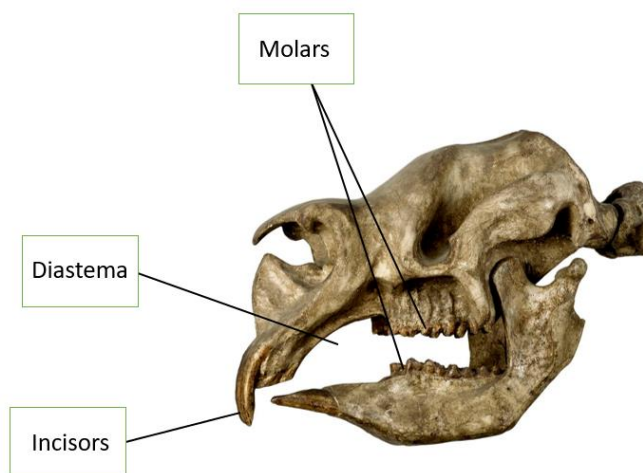
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Question 27 (4 marks)

The skull below belongs to *Diprotodon optatum*, a large Australian marsupial that lived during the Pleistocene Epoch. *Diprotodon* was the first fossil mammal named from Australia and one of the most well known of the megafauna. It was widespread across Australia when the first Indigenous people arrived, co-existing with them for thousands of years before going extinct about 25,000 years ago. This specimen, along with its complete skeleton, can be viewed at Coonabarabran Visitor Centre in central New South Wales.



- a) Using the image above, predict the type of diet consumed by *Diprotodon*.

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- b) Propose two possible features of the digestive tract of *Diprotodon*. Justify your answer with reference to its diet.

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Question 28 (10 marks)

A scientist wanted to investigate the population of lady beetle species that were in direct competition for aphid prey. She set up three cultures (Culture A, B and C). The scientist added one lady beetle species (*Harmonia axyridis*) to Culture A, a different species (*Coccinella maculata*) to Culture B, and both species together to Culture C. Each culture was an isolated potted tree of a suitable species. The scientist calculated the lady beetle density in beetles/m² throughout a 30 day period and graphed her results.

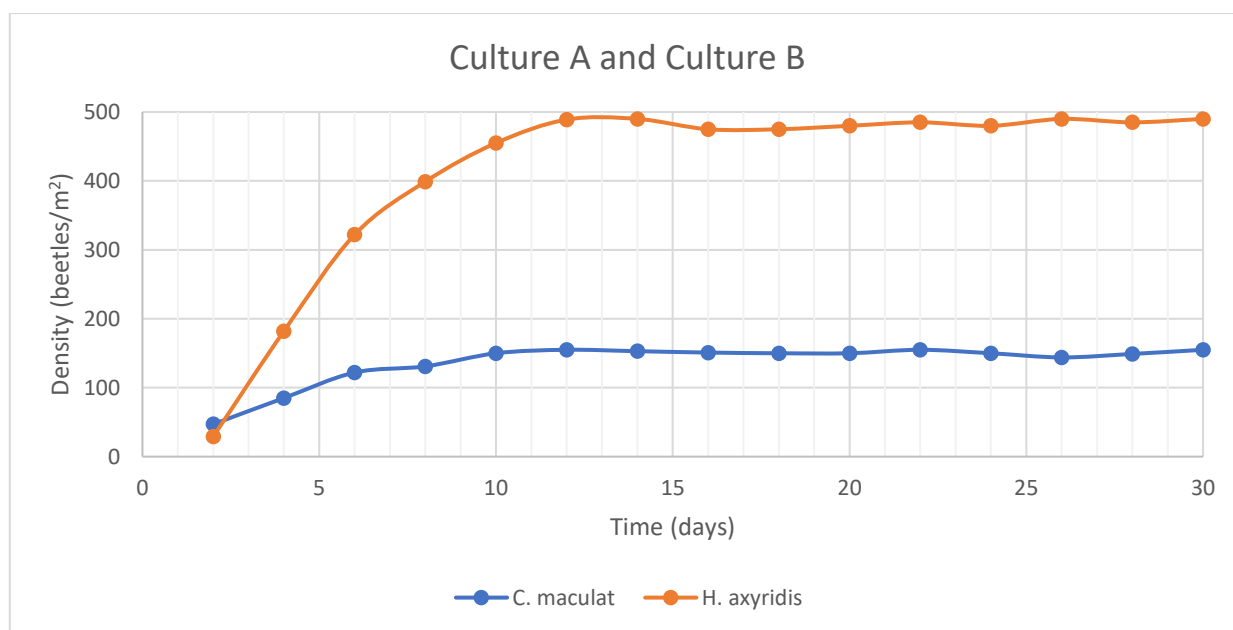


Figure 1: *H. axyridis* and *C. maculata* in separate cultures

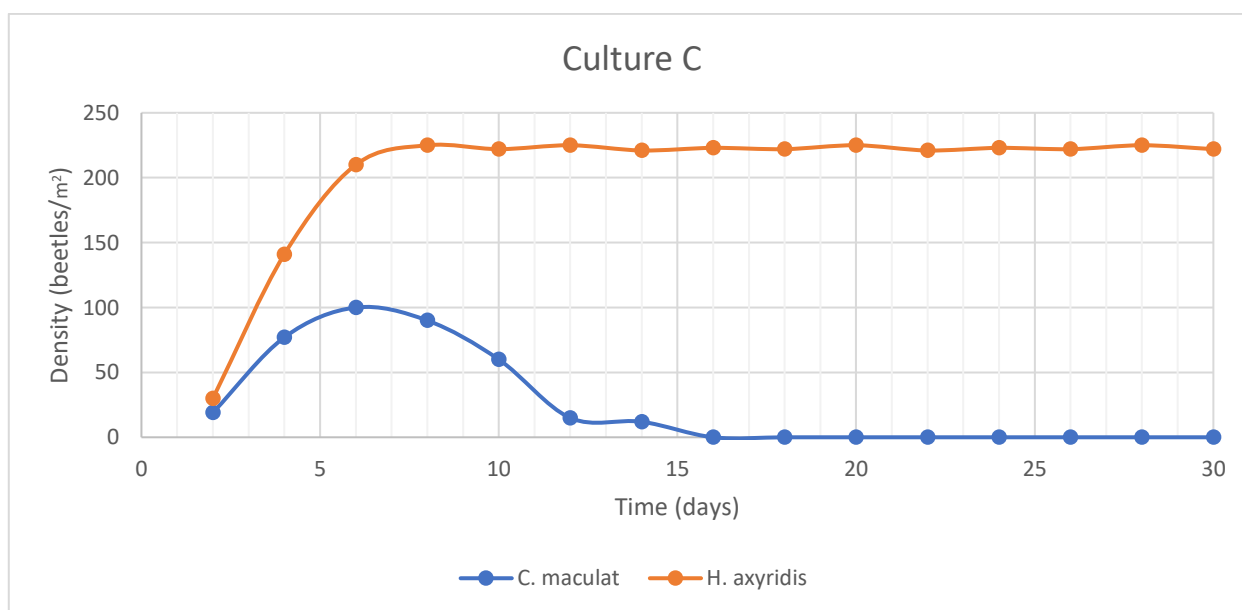


Figure 2: *H. axyridis* and *C. maculata* in a mixed culture

- a) Identify the dependent and independent variable of this experiment.

2

Dependent variable:

Independent variable:

- b) With reference to Figure 1 and 2, analyse the ecological relationship between *H. axyridis* and *C. maculat*.

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[illegible]

QUESTION 28 CONTINUES ON NEXT PAGE

- c) Assuming there were too many beetles to count directly, propose which sampling technique was used to collect the population data and justify your answer.

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- d) State one assumption that is made when estimating the abundance of a species using sampling techniques.

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END OF EXAMINATION

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Name

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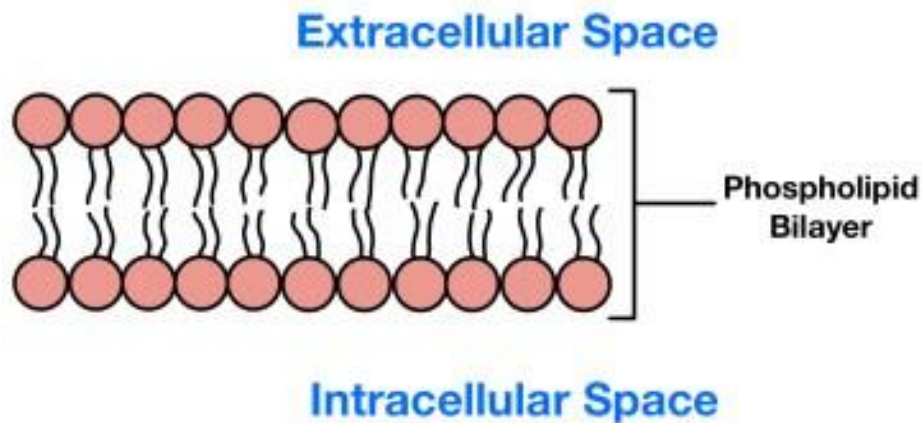
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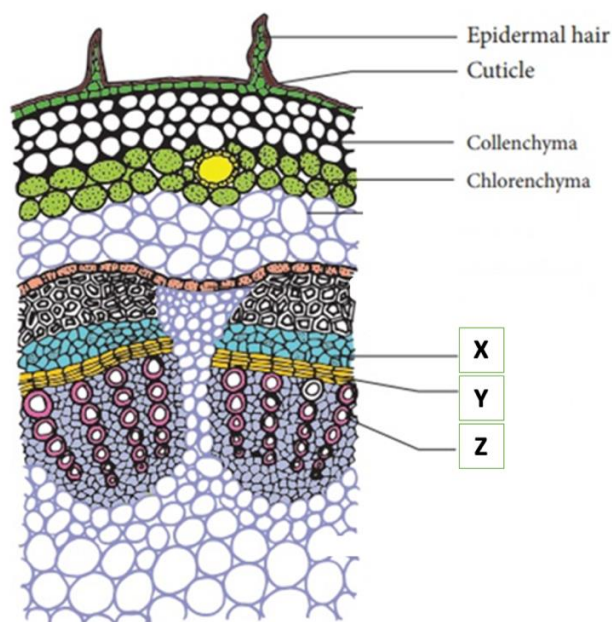
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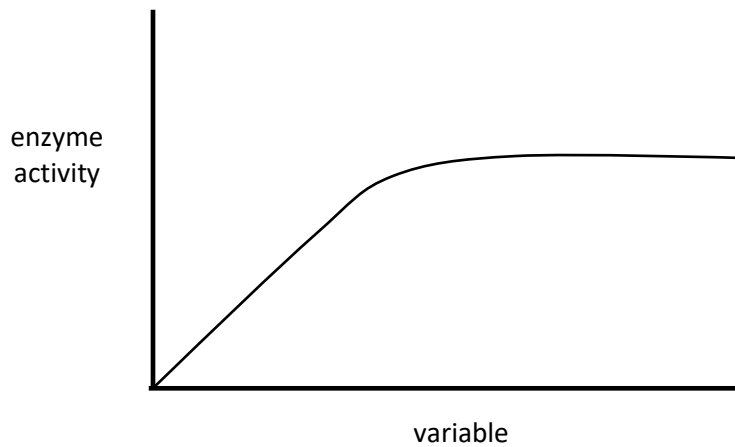
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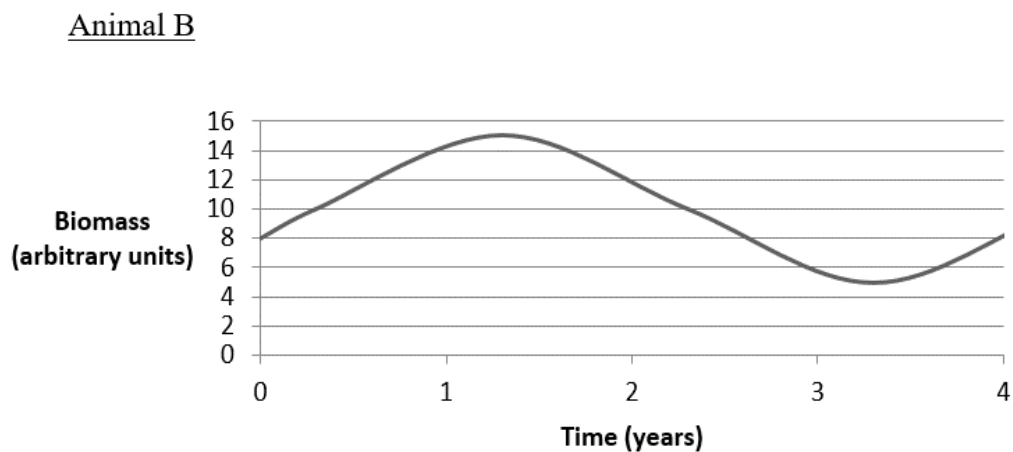
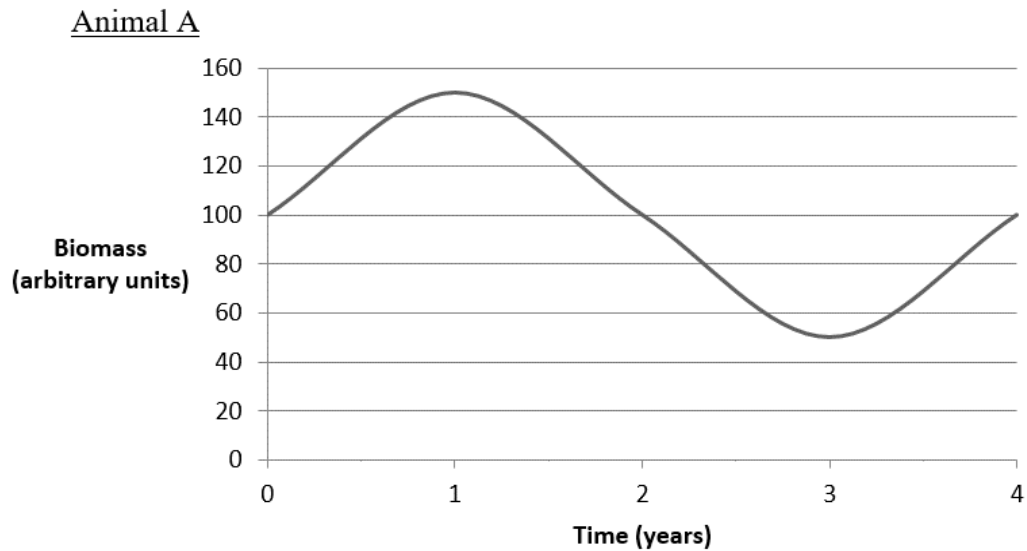
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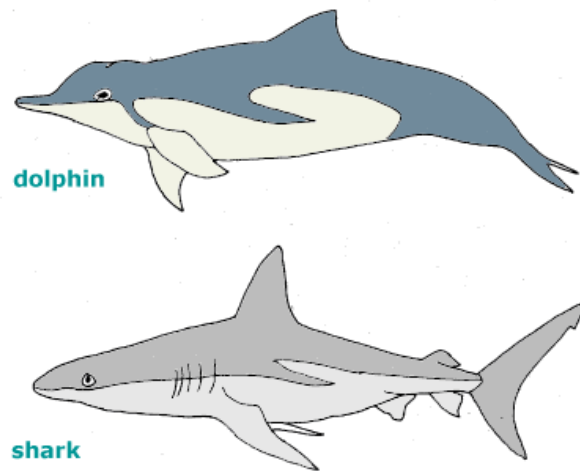
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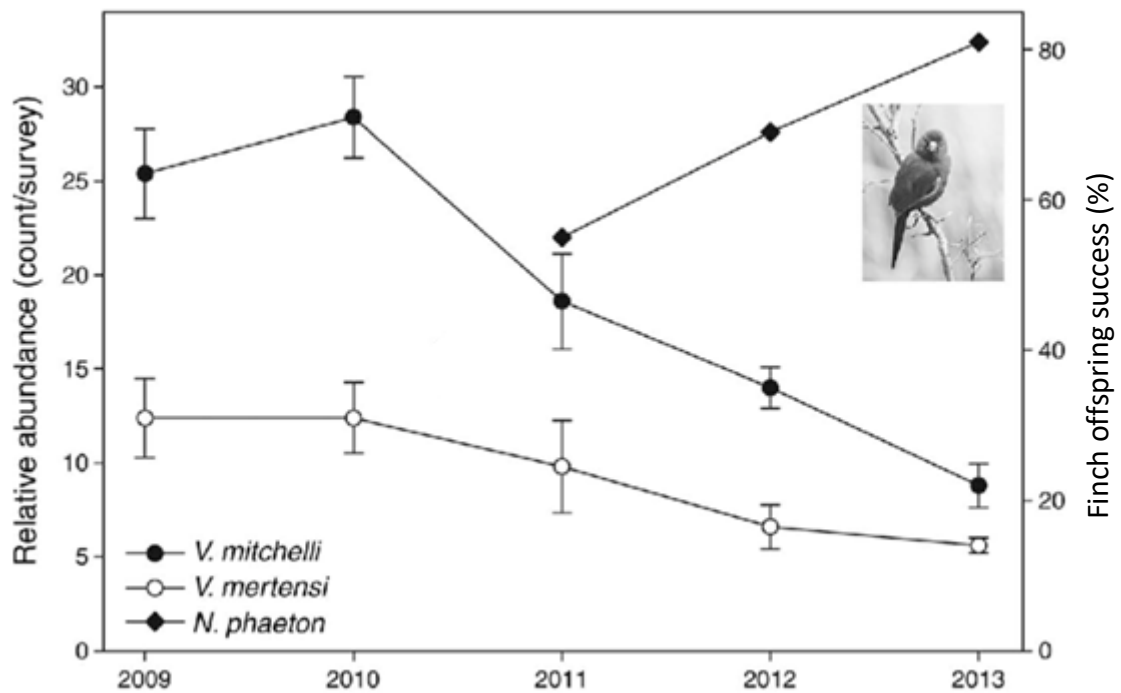
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- D. Copper ions acted as a selection pressure favouring some individuals.

Use the following information to answer Questions 13 – 14

The graph below shows the impact on the population size of two species of monitor lizards *Varanus mitchelli* and *Varanus mertensi* (abundance on left y-axis) and a species of finch *Neochmia phaeton* (offspring success on right y-axis) after the introduction of cane toads into their habitat. Cane toads often lead to the death of predator species when ingested due to the toxin secreted by the toad.



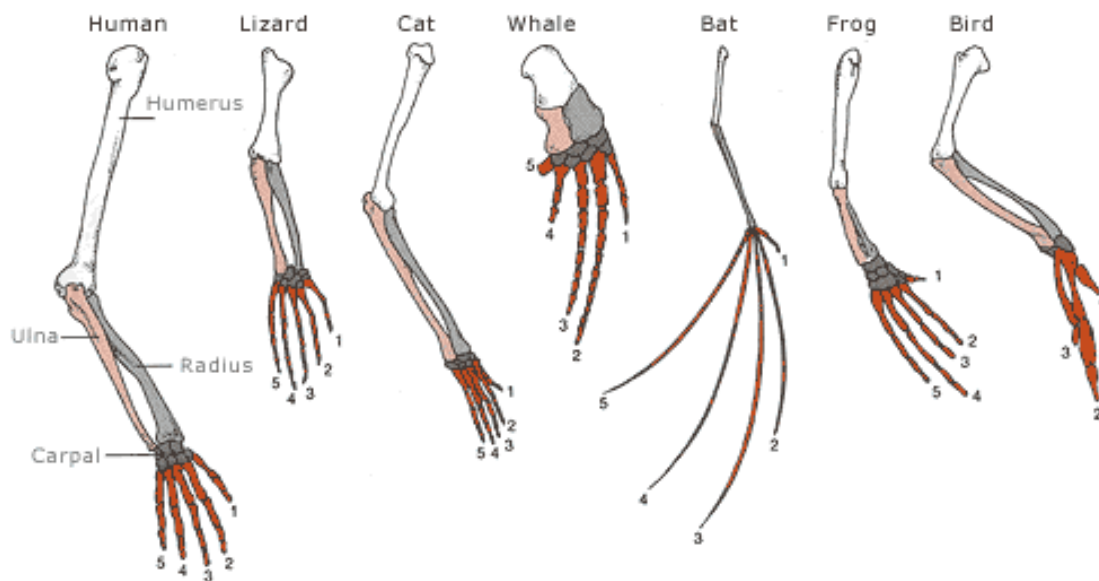
13. The cane toad was most likely introduced in what year?

- A. 2009
- B. 2010
- C. 2011
- D. 2012

14. Which statement is most accurate when describing the impact of cane toads on the monitor lizard and finch populations?

- A. The monitor lizard *V. mitchelli* has the greatest decline in relative abundance, while the finch offspring success increased at a constant rate.
- B. The monitor lizard *V. mitchelli* has the greatest decline in relative abundance, while the finch offspring success increased at an increasing rate.
- C. The monitor lizard *V. mertensi* has the greatest decline in relative abundance, while the finch offspring success increased at a constant rate.
- D. The monitor lizard *V. mertensi* has the greatest decline in relative abundance, while the finch offspring success increased at an increasing rate.

15. The diagram below shows the forelimbs of seven different vertebrate species, each of which have five digits, as well as other similarities in their structure.



An analysis of these forelimbs shows that they

- A. evolved from a common ancestor.
- B. adapted to similar environments.
- C. all belong to the same class.
- D. use the pentadactyl limb for the same function.

Use the following information to answer Questions 16 – 17

A student conducted an experiment to determine how certain variables affect the rate of transpiration. She took four cuttings of a plant and set up her experiment in four identical test tubes under the conditions outlined in the table below.

Test tube	Air temperature (°C)	Wind speed (km hr ⁻¹)	Humidity (%)
A	10	0	75
B	15	10	50
C	10	15	25
D	15	10	0

16. Which test tube would retain the most water after they have all been exposed to these conditions for the same amount of time?

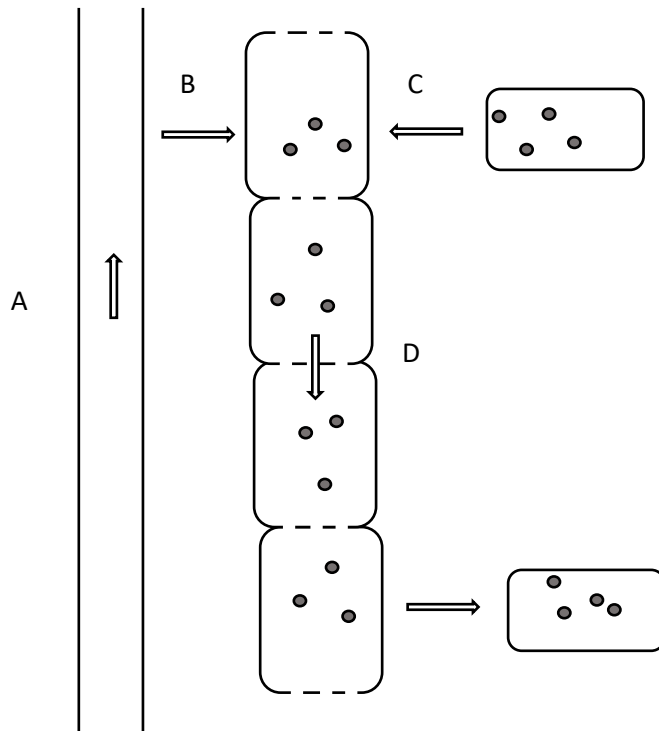
- A. A
- B. B
- C. C
- D. D

17. Which pair of test tubes would you need to compare to show the effect of humidity on transpiration?

- A. A and B
- B. B and C
- C. B and D
- D. C and D

Use the following information to answer Questions 18 – 19

The diagram below shows the movement of substances through plant vascular tissue.



18. Which arrow represents a process which uses active transport?

- A. A
- B. B
- C. C
- D. D

19. What is the substance whose movement is represented by the arrow at B?

- A. Sucrose
- B. Starch
- C. Chlorophyll
- D. Water

20. A student was studying four unlabelled cell samples. She identified and counted some organelles in each cell sample and recorded her results in the table below.

Cell sample	Number of chloroplasts	Number of mitochondria
1	0	30,000
2	0	5,000
3	0	450
4	60	300

Which of the following could be true of the cell samples?

- A. Cell sample 1 is a red blood cell.
- B. Cell sample 4 is a prokaryotic cell.
- C. Cell sample 3 is a mesophyll cell.
- D. Cell samples 3 and 4 are plant cells.

END OF SECTION I

Section II 50 marks

Attempt questions 21 – 28

Allow about 1 hour and 25 minutes for this section

Please write all answers clearly in the spaces provided. The number of lines indicates the expected length of your response.

Question 21 (4 marks)

Complete the table below by writing **increase** or **decrease** in each box to indicate how the blood composition changes as it moves through the organs listed.

Organ or tissue	Changes in concentration of the component in blood		
	Oxygen	Carbon dioxide	Glucose
Heart	Decrease	Increase	Decrease
Lungs	Increase	Decrease	Decrease
Small intestine	Decrease	Increase	Increase
Muscle	Decrease	Increase	Decrease

1 mark per correct ROW. No half marks.

Question 22 (3 marks)

Compare and contrast arteries, veins and capillaries by completing the table below.

Vessel Type	Similarity	Difference
Artery	All are vessels which carry blood	Has thick, elastic walls OR carries blood away from the heart
Vein		Has thin walls with less elasticity OR carries blood towards the heart
Capillary		Has walls that are one cell thick OR carries blood from arteries to veins

1 mark – one similarity identified.

1 mark – the differences distinguish between all vessel types.

1 mark – differences are like-for-like.

Note:

- The marking scheme meant that students who did not know one or more of these vessels were limited to 1/3.
- Do not say that all arteries carry oxygenated blood/veins carry deoxygenated blood. The pulmonary loop is an exception to this generalisation. *This did not incur deductions THIS TIME.*
- You need to choose your words more carefully. Arteries carry blood *away from* the heart, not just *out of* the heart.

Question 23 (3 marks)

Diabetes is a disease in which the body is unable to regulate blood sugar levels. Individuals with diabetes often have elevated levels of glucose in their blood because the hormones required to maintain regular glucose levels are not produced or do not function effectively. A high concentration of sugars in the blood can dehydrate the body cells.

Explain why a high blood glucose concentration can cause dehydration in the body's cells.

1 mark – high [glucose] in blood and low [glucose] in body cells.

1 mark – water moves via osmosis from low [solute] to high [solute].

1 mark – net movement of water out of the cells and into the blood, dehydrating the cells.

Most students who recognised that the question was about osmosis were able to answer succinctly and effectively.

Notes:

- Although 'movement from high water concentration to low water concentration' was accepted, it is awkward terminology and is primarily intended as a memory tool. Please explain in terms of solute concentration in future.
- Excellent to see almost all students attempting to link back to the question stem.

Many students seem to have concerning misconception that mammalian cells rely primarily on the water produced by respiration. This IS WRONG. We are, on average, 60-70% water. Ask yourself why you are drinking 8 glasses of water a day if none of it matters and you're just going to burn glucose to obtain H₂O. Please do NOT drink 8 glasses of glucose concentrate a day.

Question 24 (4 marks)

Pulmonary emphysema is a lung condition characterized by the enlargement of the alveoli in the lungs. The alveoli increase in size as the alveolar walls break down, decreasing the surface area of functional lung tissue. Pulmonary emphysema usually affects the middle aged or older population because it takes time to develop with the effects of tobacco smoking or vaping, although a genetic risk factor may lead to the condition presenting earlier. Symptoms include breathlessness and feeling fatigued.



Explain how emphysema leads to these symptoms.

Marks	Criteria
4	Thorough explanation with integration throughout and link to stem
3	Explanation provided with some integration
2	Basic explanation
1	Some relevant info

Key points:

- Reduction in SA of alveolar membrane (ideal but not essential for full marks)
- Reduced rate of gas exchange and reduced absorption of oxygen into the blood → leads to breathlessness
- Less oxygen in blood and hence less delivered to body's cells
- With limited oxygen, body's cells cannot undergo sufficient cellular respiration for energy and person feels fatigued.

Notes:

- Don't restate information from the stem unless you have included new information
- Responses need to be specific e.g. "Less OXYGEN diffuses from the LUNGS into the BLOOD" not simply "less diffusion of oxygen"
- Cellular respiration does NOT produce glucose, we are not plants!
- Respiration is not the same as breathing
- Number of ticks does not equal number of marks

Question 25 (8 marks)

On 26th April 1986, the worst nuclear accident in history occurred when a reactor in the Chernobyl Nuclear Power Plant exploded and burned. Massive quantities of radioactive material were emitted from the plant and residents were evacuated from the area. A 4,000 km² exclusion zone was established around the plant and is still in place today.

Despite the dangerously high levels of radiation in the exclusion zone of Chernobyl, many pet dogs survived and reproduced. The descendants of these dogs are of huge interest to scientists due to their survival in the face of extraordinary levels of radiation.

From 2017-2019, a team of scientists carried out an investigation into a group of dogs that lived at the base of the Chernobyl Nuclear Power Plant and hence experienced the highest radiation levels in the area. Blood samples were taken from the animals and genetic analysis was done to compare the genes of these dogs with dogs living in a town called Slavutych (30 km away from the plant). The results showed that the dogs living at the base of the Chernobyl Nuclear Power Plant were genetically different from the dogs living in Slavutych.

- a) Using your knowledge of Evolution by Natural Selection, explain how the Chernobyl dogs became **genetically different to the Slavutych dogs**.

5

1 mark – (V) **Explicitly** identifies variation in the original population e.g. Variation exists in the original population of Chernobyl dogs.

1 mark – (S) **Explains** selective advantage e.g. The explosion that led to high levels of radiation resulted in a selection pressure on the individuals in the Chernobyl population, favouring those that are more resistant to radiation.

1 mark – (R) **Links to reproduction and inheritance** e.g. The individuals with the favourable trait survive better, reproduce more **AND** pass down the favourable trait/genes to the next generation

1 mark – (A) **Links to allele/gene/trait frequency change** (insufficient to say the dogs have 'adapted') e.g. Over time, the proportion/frequency of individuals with the favourable trait/gene will increase.

1 mark – (D) Relates the above to the question (insufficient to only say the Slavutych dogs did not experience the selection pressure or did not evolve) e.g. As Slavutych dogs did not experience the same selection pressure, they did not undergo natural selection for the resistance trait/gene and became genetically different to the Chernobyl dogs.

Better responses explained very clearly that the same trait would be 'neutral' in the Slavutych dog population and therefore the Slavutych population would not experience an increase in the frequency of dogs with the resistance.

Sample Answer

There was existing variation among the Chernobyl dog population prior to the nuclear accident, ^{due to genetic mutations} where some dogs were more tolerant to radiation. After the nuclear accident, the high levels of radiation acted as a selection pressure on the population, selecting for the more favourable trait of tolerance to radiation among the dogs. Thus the dogs that were more tolerant to radiation survived longer and reproduced more than those sensitive to radiation, thus passing down their favourable trait of tolerance to radiation to their offspring. Over several generations, through this process of natural selection, tolerance to radiation became the more common trait among the Chernobyl dog population. However, the Slavutych dog population was not exposed to this radiation and thus it did not act as a selection pressure on them. Thus in the Slavutych dog population tolerance to radiation has not been selected for and thus there was little ^{change} to no ~~change~~ in the proportion of Slavutych dogs with tolerance to radiation, unlike the increase in proportion of this trait among the Chernobyl dogs. Thus over several generations, the ^{Chernobyl} ~~Slavutych~~ dog population has become genetically different to the Slavutych dog population, as tolerance to radiation became a more common trait ^{in the former population}, due to the presence of radiation as a selection pressure.

b) After many generations, it is possible for speciation to occur in the dog population in Chernobyl. Explain how this might eventuate.

3

1 mark – (S) Shows understanding of the term 'species' e.g. group of individuals that can interbreed.

Note: Better responses included that they need to be able to produce fertile and viable offspring

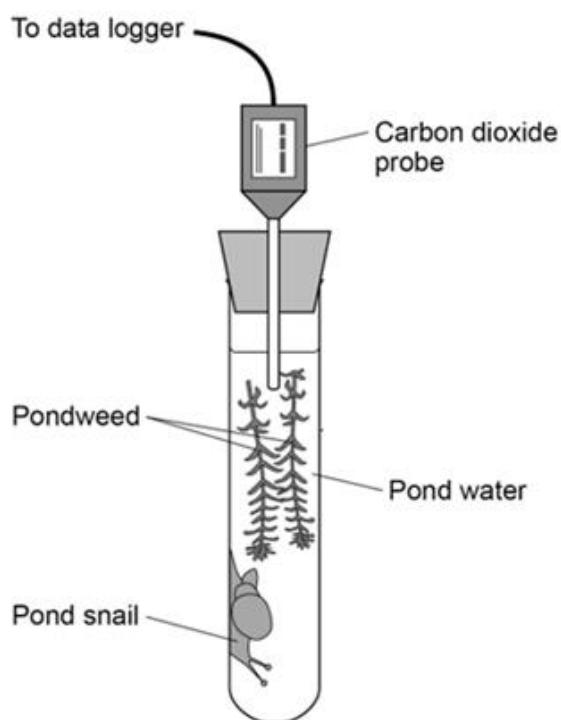
1 mark – (I) Identifies the requirement for isolation e.g. Both populations would have to be reproductively and/or geographically isolated from each other.

OR Describes a particular type of isolation e.g. behavioural isolation.

1 mark – (C) Links isolation AND accumulation of evolutionary changes to speciation (insufficient to only say 'because they are exposed to different selection pressures') e.g. As the populations become isolated and accumulate MORE evolutionary changes/adaptations/genetic differences, this would result in their inability to interbreed, speciation will occur between the two dog populations.

Question 26 (14 marks)

A scientist was investigating respiration and photosynthesis using some pondweed and a pond snail. The diagram below shows the apparatus used.



The data logger recorded the concentration of carbon dioxide continuously throughout a 10 day period. The results are shown in the table below.

Time (days)	Concentration of carbon dioxide (ppm)
0	381
2	381
3	381
5	411
7	455
9	522
10	599

a) Construct a graph for the data in the table. Include an appropriate line of best fit. **4**

1 mark – correct axis labels including units.

1 mark – correct points plotted.

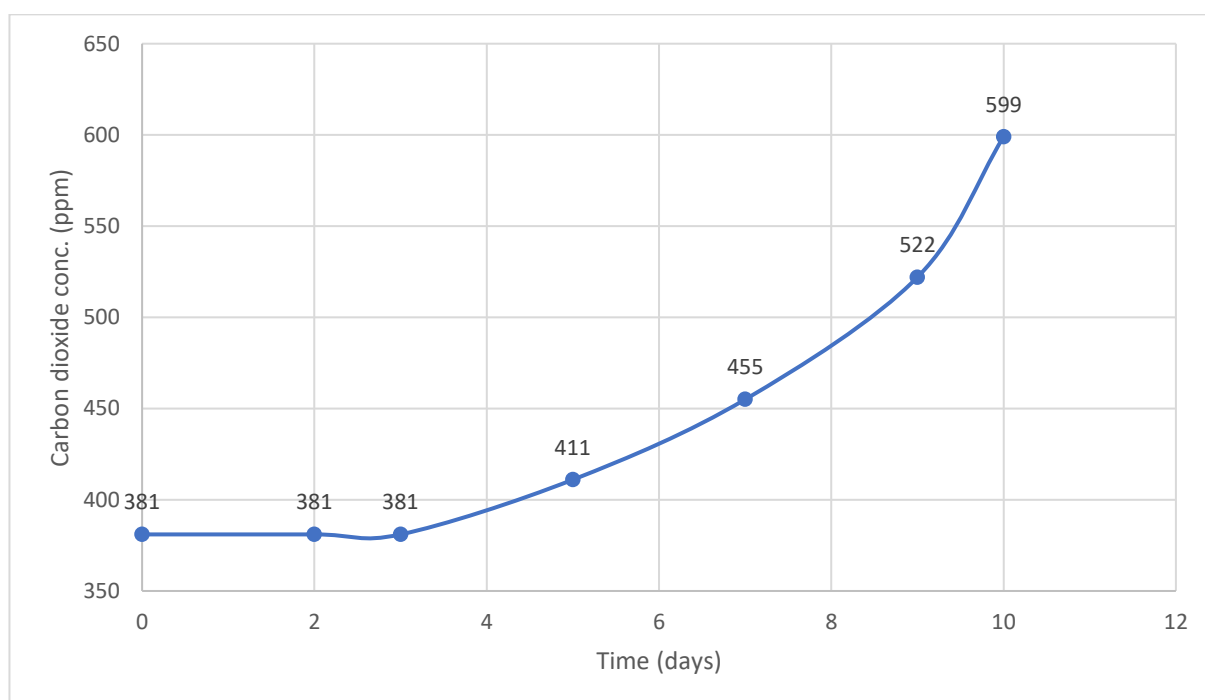
1 mark – appropriate scale; takes up at least 80% of each axis.

1 mark – appropriate line of best fit; curved and goes through all points; no extrapolation.

Notes:

Points 0-3 must be flat.

Values at origin must be labelled, does not have to be (0,0).



b) Describe the trend in the graph. **3**

1 mark – describes trend from day 0 – 3. CO₂ conc was constant at 381 ppm.

1 mark – describes trend from day 3 – 10. CO₂ conc increased at an increasing rate, reaching a peak of 599 ppm.

1 mark – uses data from the graph in description of trends.

Note: exponential is a specific mathematical function, an increasing curve is NOT always exponential. No marks deducted for describing curve as exponential but please don't use unless the relationship IS exponential

A statement describing the trend for the entire graph is not necessary as there are two distinct stages in the graph.

- c) On Day 4, the scientist completely covered the test tube with black paper.

Explain how this accounts for the shape of the graph.

4

1 mark – identifies CO₂ conc increased after day 4.

1 mark – links no sunlight to no photosynthesis occurring.

1 mark – links no photosynthesis to CO₂ not being consumed.

1 mark – CO₂ is being produced by the **pond weed** and **snail** as a product of respiration, resulting in a net increase in CO₂ during this period.

Explanation of days 0-3 not needed, answer needs to relate to day 4 onwards.

STUDENTS NEED TO LEARN THE REACTIONS FOR PHOTOSYNTHESIS AND CELLULAR RESPIRATION!!!

- d) At the conclusion of her experiment, the scientist discovered that the pond weed and snail had died. Using your knowledge of cellular respiration, explain why this occurred.

3

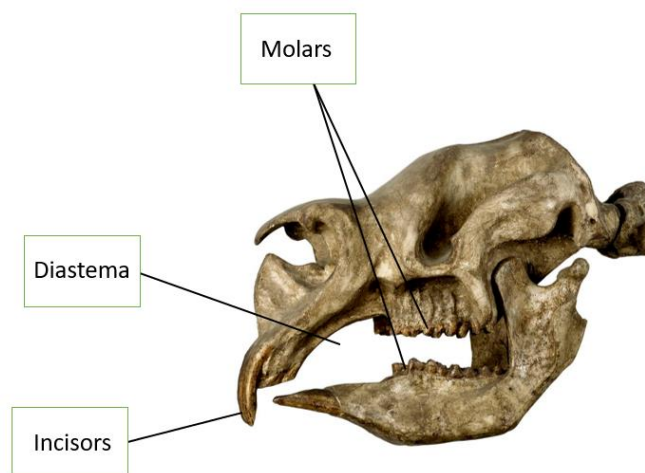
Marks	Criteria
3	No light → no photosynthesis → oxygen no longer being produced Cellular respiration requires glucose + oxygen → remaining oxygen will be used in cellular respiration Organisms die due to inability to undergo cellular respiration as a result of depleted oxygen
2	Relates one of the above to the snail suffocating
1	Describes cellular respiration or states that O ₂ is necessary for cellular respiration

Careful with using the terms **nutrients**, **food**, **energy** and **glucose**, they are not interchangeable. Students need to be clear about which they are referring to.

Answers effectively linking build up of CO₂ from cellular respiration to decrease in pH also accepted.

Question 27 (4 marks)

The skull below belongs to *Diprotodon optatum*, a large Australian marsupial that lived during the Pleistocene Epoch. *Diprotodon* was the first fossil mammal named from Australia and one of the most well known of the megafauna. It was widespread across Australia when the first Indigenous people arrived, co-existing with them for thousands of years before going extinct about 25,000 years ago. This specimen, along with its complete skeleton, can be viewed at Coonabarabran Visitor Centre in central New South Wales.



a) Using the image above, predict the type of diet consumed by *Diprotodon*.

1

1 mark – herbivorous diet. Also accepted 'herbivore'

b) Propose two possible features of the digestive tract of *Diprotodon*. Justify your answer with **reference to its diet**.

3

c) Criteria	Mark
Correctly identifies TWO distinguishing features e.g. long digestive tract, enlarged caecum, rumen and justifies both features with reference to diet .	3
Correctly identifies ONE distinguishing feature e.g. long digestive tract, enlarged caecum, rumen and justifies this feature with reference to diet. OR Correctly identifies TWO general features and justifies this feature with reference to diet.	2
Provides relevant information	1

Number of ticks ≠ marks

Examples for herbivorous diet:

- Large caecum/rumen → allows for digestion of cellulose in plant diet (better responses emphasised that the diet is high in cellulose)
- Short small intestine (non-ruminant) → minimal nutrient absorption prior to digestion in caecum OR the large caecum is responsible for absorption as well
- Long large intestine (non-ruminant) → maximise nutrient absorption following digestion in caecum
- Overall long digestive tract → maximise digestion of cellulose which is **slow** OR maximise nutrient absorption as plant diet is **nutrient poor**

Examples for carnivorous diet (mistake carried):

- Short digestive tract/small intestine → digestion (NOT absorption) of meat/protein is quick
- Highly acidic stomach → pathogens in meat
- Smaller caecum → no need to digest cellulose (better responses emphasised that the diet is low in cellulose)

Question 28 (10 marks)

A scientist wanted to investigate the population of lady beetle species that were in direct competition for aphid prey. She set up three cultures (Culture A, B and C). The scientist added one lady beetle species (*Harmonia axyridis*) to Culture A, a different species (*Coccinella maculata*) to Culture B, and both species together to Culture C. Each culture was an isolated potted tree of a suitable species. The scientist calculated the lady beetle density in beetles/m² throughout a 30 day period and graphed her results.

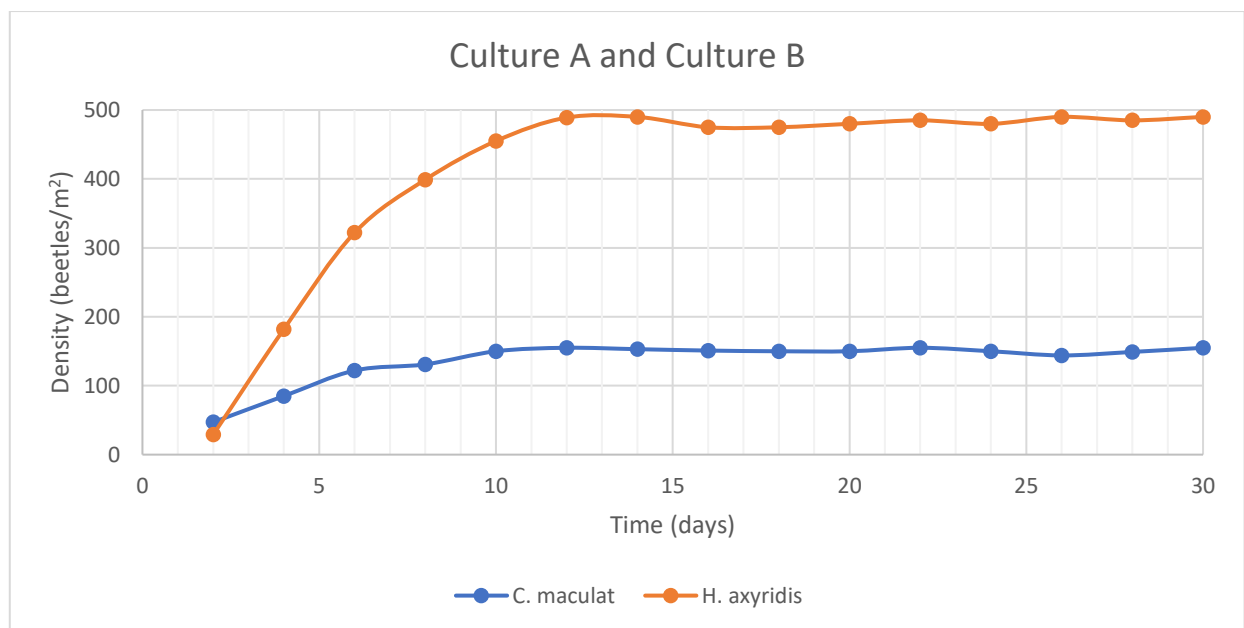


Figure 1: *H. axyridis* and *C. maculata* in separate cultures

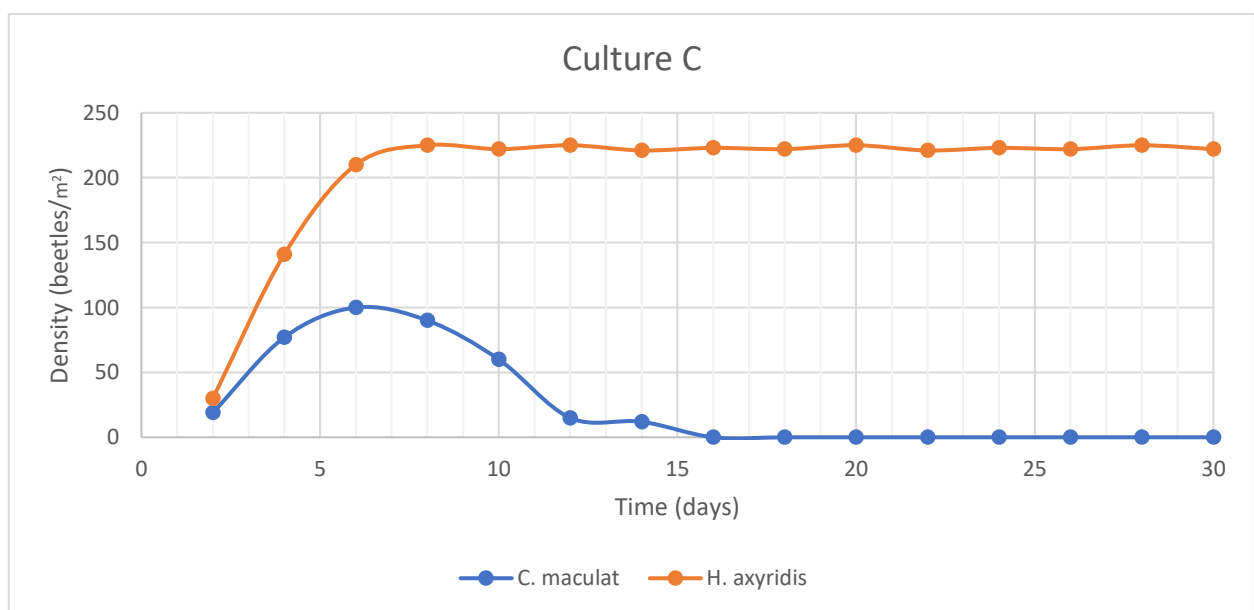


Figure 2: *H. axyridis* and *C. maculata* in a mixed culture

a) Identify the dependent and independent variable of this experiment.

2

Dependent variable: 1 mark – beetle density.

Independent variable: 1 mark – type of culture (ie mixed or not-mixed) – *also accepted 'species of beetle' but this is not as good an answer.*

Reminder: double-dipping receives zero.

b) With reference to Figure 1 and 2, analyse the ecological relationship between *H. axyridis* and *C. maculata*.

5

1 mark – describes trend in Fig 1 for both species as increasing in density until reaching carrying capacity (by day 12)

1 mark – **explains** difference in carrying capacities in Fig 1: *H. axyridis* has the higher carrying capacity because it is better suited to the environment.

1 mark – describes trend in Fig 2 for *C. maculata* as increasing until day 6 to 100 beetles/m², then decreasing until locally extinct by day 16.

1 mark – describes trend in Fig 2 for *H. axyridis* as increasing until day 8, then plateauing at 225 beetles/m² AND identifies that this carrying capacity is lower than when *H. axyridis* was cultured alone.

1 mark – concludes the ecological relationship is competition / competitive exclusion

Notes:

- You need to get into the habit of describing whole trends, not just picking one piece of information. Many students did not describe trends methodically enough to set themselves up for an in-depth analysis.
- There is no segment of either graph where density increases at an increasing or exponential rate. Describe the graph you are given; don't describe what you've memorised during revision.
- We would like to see better use of terminology in future: 'better adapted to the environment' vs 'stronger'; 'competing' vs 'fighting'; 'ecological niche'.

- c) Assuming there were too many beetles to count directly, propose which sampling technique was used to collect the population data and justify your answer.

2

1 mark – identifies capture-recapture OR quadrat sampling

1 mark – justification eg beetles are highly mobile OR this will allow population to be estimated despite the overall number being too large to count

Note: 'the beetles are slow' or similar was not accepted as a justification. They can fly! Lady beetles were also used as an example of highly mobile organisms during class.

- d) State one assumption that is made when estimating the abundance of a species using sampling techniques.

1

1 mark – correct assumption eg: capture-recapture technique relies on the assumption that the marked individuals will disperse back into the population when released.

Note:

- Any technique could be used for d), it did not need to be the same technique as in c).
- Good procedure eg 'ensure that your marker/tag does not kill the organism' is not the same as an assumption.
- Some students seemed to be thinking of a correct assumption but did not express it clearly. Eg 'assume no organisms die' is not correct; 'assume there is no significant change in population size during the sampling period' IS correct, and so is 'assume that marked organisms are just as likely to be recaptured as unmarked organisms'. Wording is important.