



Biology

2022

Preliminary Assessment Task 3

Yearly Examination

General Instructions

- Reading time – 5 minutes
- Working time – 120 minutes
- Board approved calculators may be used
- Write using black pen
- Draw diagrams using 2B pencil
- Write your NESA number at the top of this page and the Multiple-Choice answer sheet at the back of this exam paper
- Additional writing paper is available at the back of the Answer Booklet

Weighting – 40%

Total marks – 75

Section I (Questions 1-20)

Multiple choice question (20 marks)

Section II (Questions 21-)

Extended response (55 marks)

Attempt All Questions

Outcome	Questions	Total
Knowledge and Understanding	MC, 22, 24, 25, 26, 27, 28, 29	/53
Skills	21, 23, 30, 31	/22
	Total	/ 75

Section I – 20 marks

Attempt Questions 1-20

Allow about 35 minutes for this section

Use the multiple-choice answer sheet.

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.

A B C D

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.

A B C D

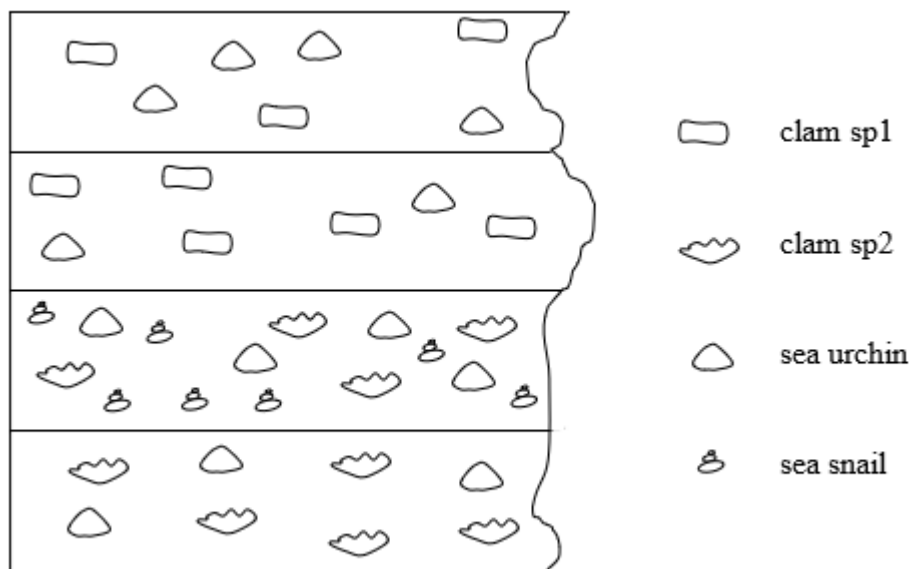
Section I

1. Camels are able to conserve water by concentrating their urine to a much greater extent than most other mammals.

This is an example of a:

- (A) behavioural adaptation
- (B) structural adaptation
- (C) psychological adaptation
- (D) physiological adaptation

2. Four fossil species are found within the profile.

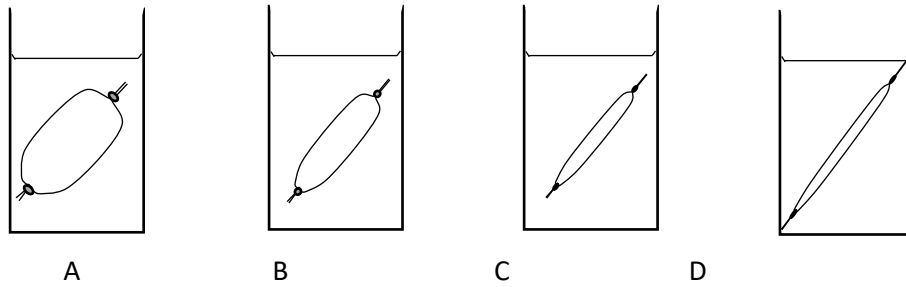


According to this evidence, which is the youngest fossil?

- (A) clam sp 1
- (B) clam sp 2
- (C) sea urchin
- (D) sea snail

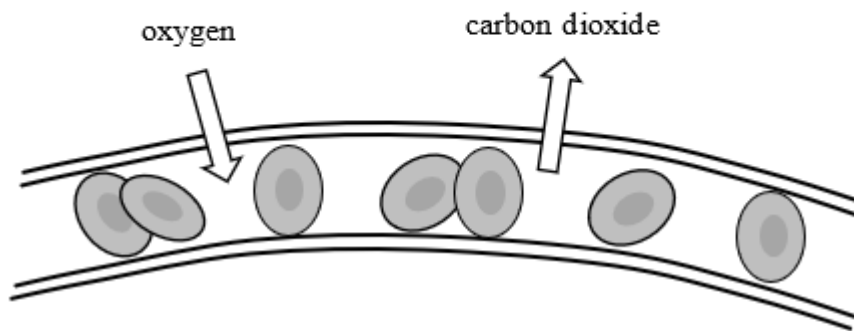
3. Four dialysis tube 'sausages', each containing 10% starch solution, and each looking identical, were made.

They were placed in beakers containing four different concentrations of starch, and left overnight.



Which beaker contained the lowest concentration of starch solution?

- (A) A
 - (B) B
 - (C) C
 - (D) D
4. The diagram below shows a capillary passing through an organ in the human body



Identify the organ.

- (A) lungs
- (B) heart
- (C) small intestine
- (D) active muscle

Use the following information to answer Questions 5 –6.

A student wanted to investigate the effect of light on photosynthesis. They decided to measure the production of starch in a leaf, as starch is a polymer made from glucose (a product of the photosynthetic reaction). The student placed a plant in a cupboard for one week and another identical plant on a sunlit windowsill for the same time. At the end of the week, the student boiled a leaf from each plant to break the cell walls and release chemicals from within the cells. They then tested the leaves for the presence of starch by using iodine. When adding iodine, a colour change from orange-brown to blue-black occurs if starch is present.

On the addition of iodine, the leaf from the plant that was kept on the sunlit windowsill turned blue-black in colour, and the leaf from the plant that was kept in the cupboard remained orange-brown in colour.

5. Which of the following is the most suitable hypothesis for the student's investigation?
- (A) Chlorophyll is required for photosynthesis to occur.
 - (B) Light is required for photosynthesis to occur.
 - (C) If a plant is kept in a cupboard, then it will photosynthesise.
 - (D) If a plant is green, then it will photosynthesise.
6. Which of the following lists the variables that the student would need to keep controlled to make the test valid?
- (A) amount of soil in each pot, amount of water added to each plant, amount of light each plant was exposed to, genetics of the plants
 - (B) amount of soil in each pot, amount of water added to each plant, genetics of the plants, the cupboard one plant was placed in
 - (C) amount of soil in each pot, amount of water added to each plant, amount of light each plant was exposed to, amount of iodine added to each leaf
 - (D) amount of soil in each pot, amount of water added to each plant, genetics of the plants, amount of iodine added to each leaf

7. The photomicrograph below is of a cell organelle.

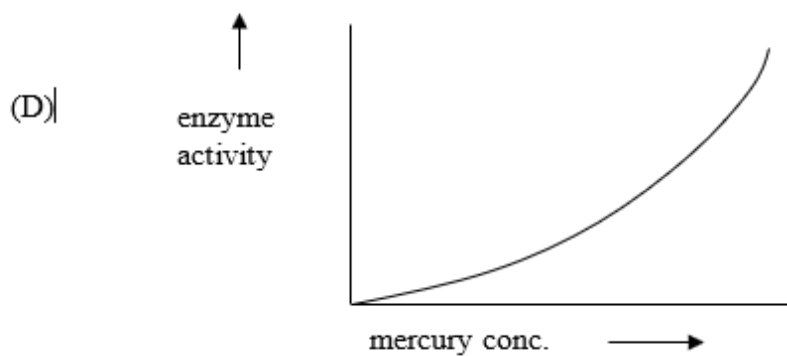
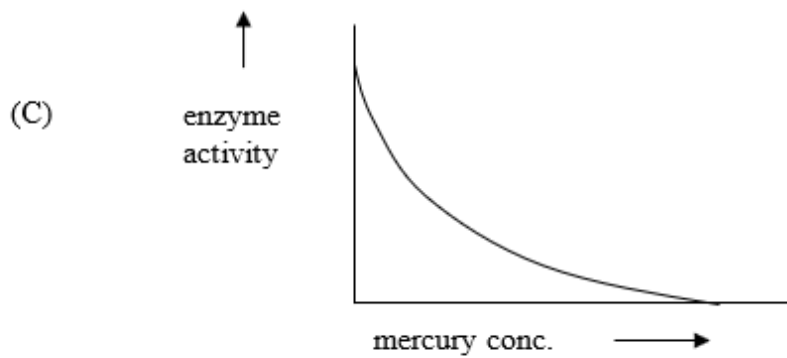
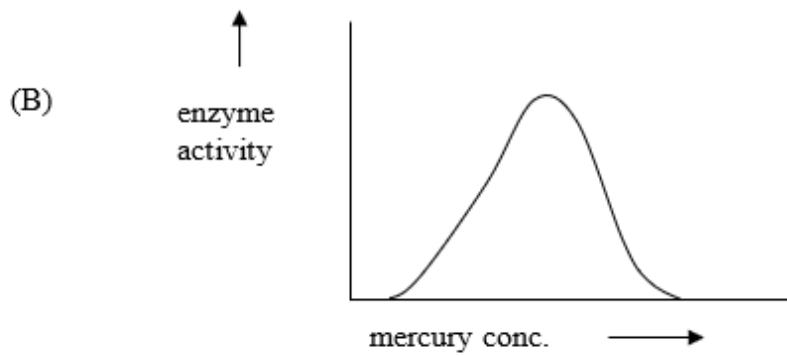
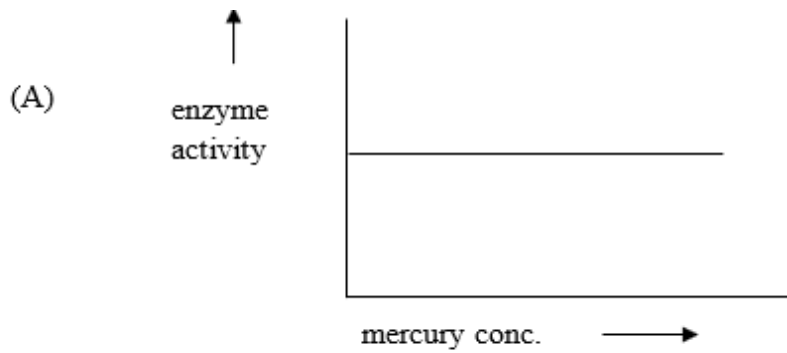


Which one of the following best describes its function?

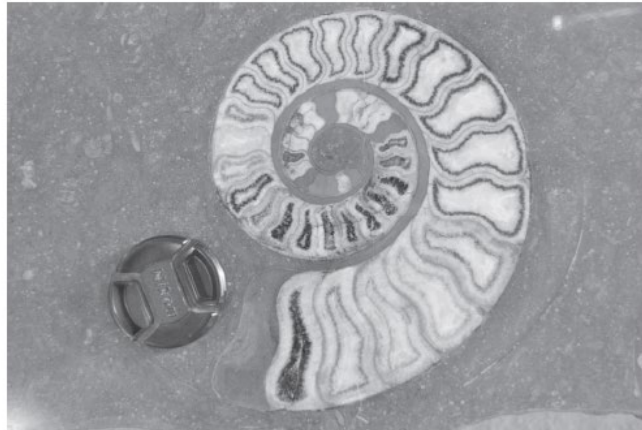
- (A) protein synthesis
- (B) photosynthesis
- (C) packaging proteins for export from the cell
- (D) aerobic respiration

8. Poisons like mercury interfere with enzyme function by partially blocking the active site.

Which graph below would you expect to best represent the relationship between mercury concentration and enzyme activity?



9. The photograph shows an ammonite fossil. The lens cap to the left of the fossil has a diameter of 6.5 cm.



Source: Reproduced with permission from Litchfield C (2021), *Ammonite fossil* [photograph].

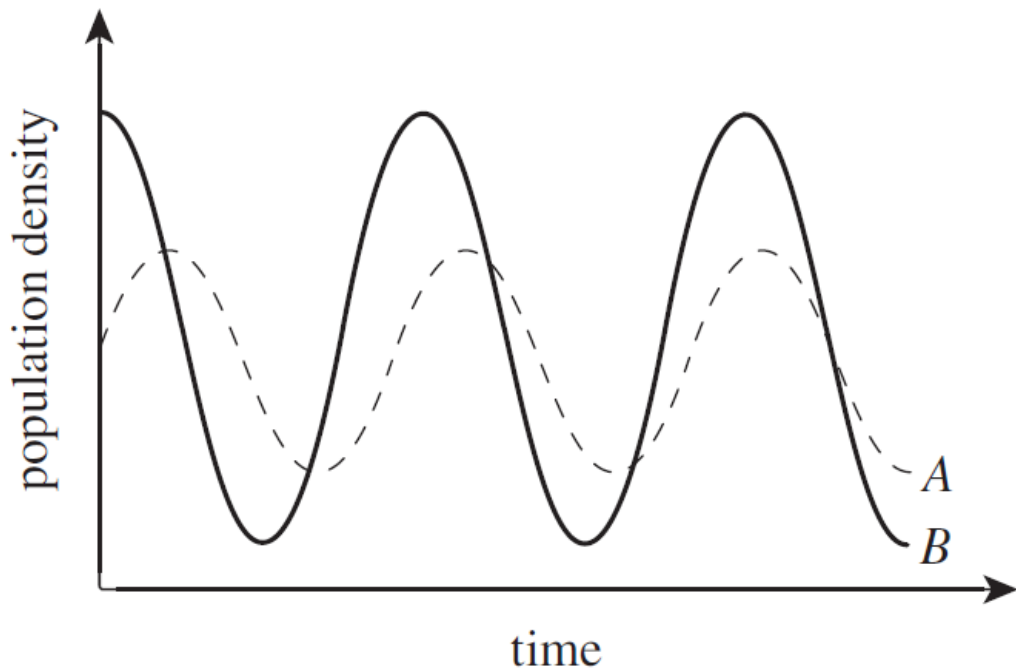
Which of the following best estimates the diameter of the ammonite?

- (A) 6–10 cm
 - (B) 15–25 cm
 - (C) 33–50 cm
 - (D) 55–62 cm
10. The North American flying squirrel and the Australian sugar glider have both developed large membranes between their forelimbs and hindlimbs to enable them to glide. They are both covered in soft brown fur with pale underbellies and large eyes. The North American flying squirrel is a placental mammal, and the Australian sugar glider is a marsupial mammal.

Which phrase best describes the similarities between these two organisms?

- (A) parallel evolution
- (B) divergent evolution
- (C) convergent evolution
- (D) adaptive radiation

11. The population density graph shows the relationship between two organisms.



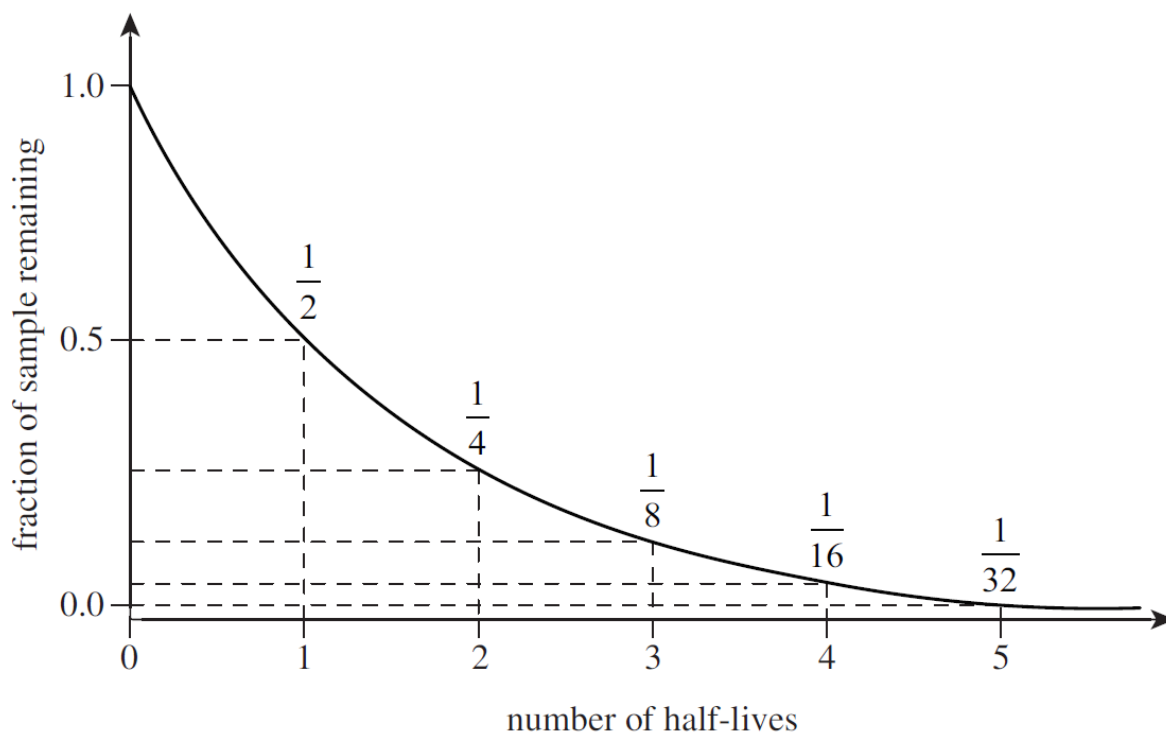
Which statement about the graph is correct?

- (A) The line labelled *A* represents the predator because there are more predators than prey in a community.
 - (B) The line labelled *A* represents the prey because there are fewer prey organisms than predators in a community.
 - (C) The line labelled *B* represents the predator because there are fewer predators than prey in a community.
 - (D) The line labelled *B* represents the prey because there are more prey organisms than predators in a community.
12. A cube has a length of 4 cm.

What is the surface-area-to-volume ratio for the cube?

- (A) 1 : 4
- (B) 4 : 1
- (C) 1 : 1.5
- (D) 1.5 : 1

13. The graph shows a generic radioactive decay curve.



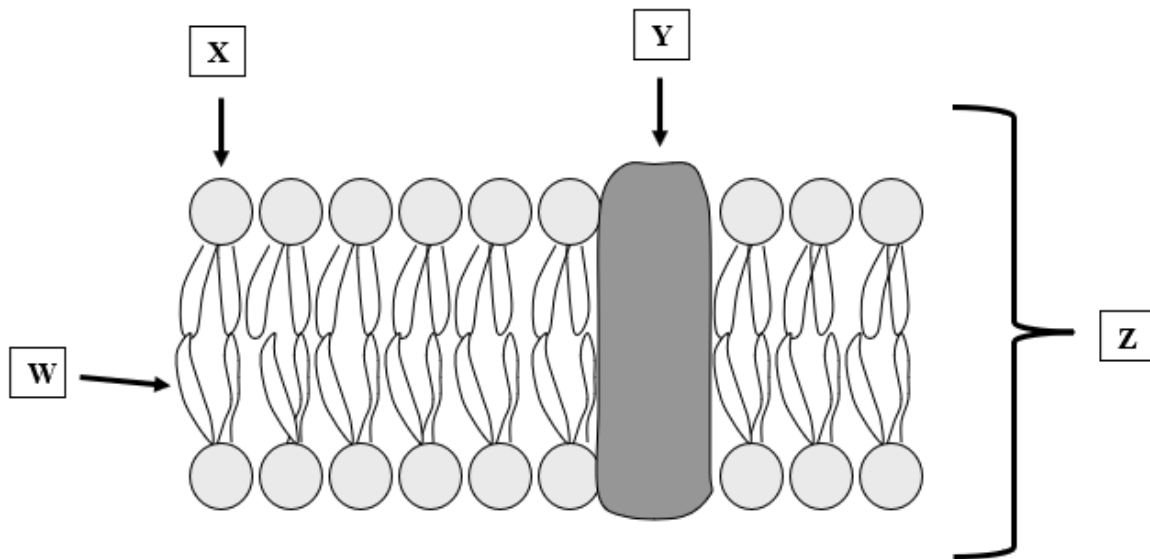
The radioisotope potassium-40 decays to a stable isotope of argon. Its half-life is about 1300 million years. Scientists can date igneous rocks by measuring the amount of potassium and argon in samples using a mass spectrometer.

Using the potassium-argon clock method, scientists dated an igneous rock (tuff) in a layer directly below a sedimentary layer of sandstone containing a trilobite fossil. The rock sample was analysed and was found to have 25% argon.

What is the best estimate for the age of the fossil?

- (A) 400 million years
- (B) 700 million years
- (C) 2.6 billion years
- (D) 2.8 billion years

The diagram below illustrates the fluid mosaic model of the cell membrane.
Use this diagram to answer Questions 14 and 15.



14. What is the correct function for the part labelled 'Y'?
- (A) Removes or secretes substances such as hormones or enzymes.
 - (B) Allow cells to recognise one another.
 - (C) Transports large molecules (or even whole cells) by engulfing them.
 - (D) Transports small organic molecules such as sugars or amino acids.
15. The phospholipid bilayer contains both hydrophobic and hydrophilic regions.
Which letter in the diagram represents the hydrophobic region?
- (A) W
 - (B) X
 - (C) Y
 - (D) Z

16. The evolution of Australia's unique life forms resulted from:

- (A) Our isolation from the rest of Gondwanan land masses.
- (B) Our invasion by early settlers.
- (C) The extinction of our megafauna.
- (D) Our unique climate.

17. Heterotrophs differ from autotrophs in their mode of nutrition. Which of the following statements correctly distinguishes heterotrophs from autotrophs?

	Heterotrophs	Autotrophs
(A)	Undergo chemical respiration	Do not undergo chemical respiration
(B)	Obtain organic nutrients by consuming other organisms; unable to photosynthesise	Produce organic nutrients by means of photosynthesis
(C)	Obtain energy from organic nutrients	Obtain energy from organic nutrients
(D)	Photosynthesise but do not respire	Respire but do not photosynthesise

18. Materials may be moved inside organisms by either active or passive transport. Which response correctly describes these two forms of transport?

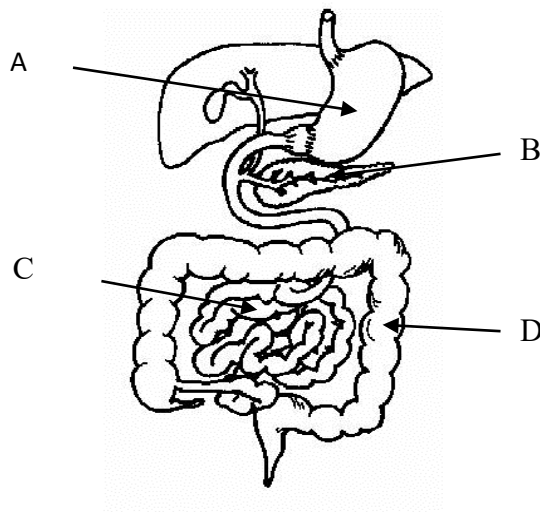
	<i>Active transport</i>	<i>Passive transport</i>
(A)	semi-permeable membrane used	semi-permeable membrane never used
(B)	energy required	energy not required
(C)	energy not required	energy required
(D)	only soluble substances transported	only insoluble substances transported

19. In terrestrial mammals the concentration of the interstitial fluid around cells is similar to the concentration of fluid inside cells.

Which of the following terms describes these concentrations?

- (A) hypertonic
- (B) osmotic
- (C) hypotonic
- (D) isotonic

20. The diagram below shows the human digestive system.



Which structure is the main site of absorption of digested food?

- (A) A
- (B) B
- (C) C
- (D) D

End of section I

2022
Biology Preliminary Examination
Multiple Choice Answer Sheet

Fill in the circle that corresponds to the most correct answer.

- | | | | | | | | | |
|-----|---|-----------------------|---|-----------------------|---|-----------------------|---|-----------------------|
| 1. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 2. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 3. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 4. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 5. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 6. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 7. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 8. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 9. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 10. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 11. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 12. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 13. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 14. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 15. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 16. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 17. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 18. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 19. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 20. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |

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2022 Preliminary Biology Examination

Section II

Answer Booklet

55 marks

Attempt Questions 21 - 31

Allow about 1 hour and 25 minutes for this section.

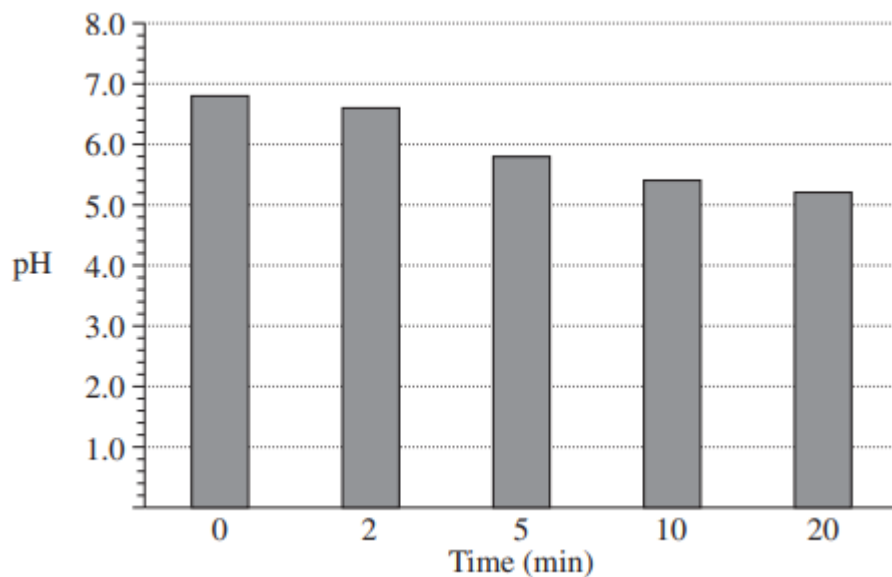
Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
 - Show all relevant working in questions involving calculations.
 - Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.
-

Question 21 (7 marks)

Students in a class conducted a first-hand investigation to test the hypothesis that if CO₂ were continually bubbled in water then the pH would decrease over time.

One student presented the data in the graph, as shown below.

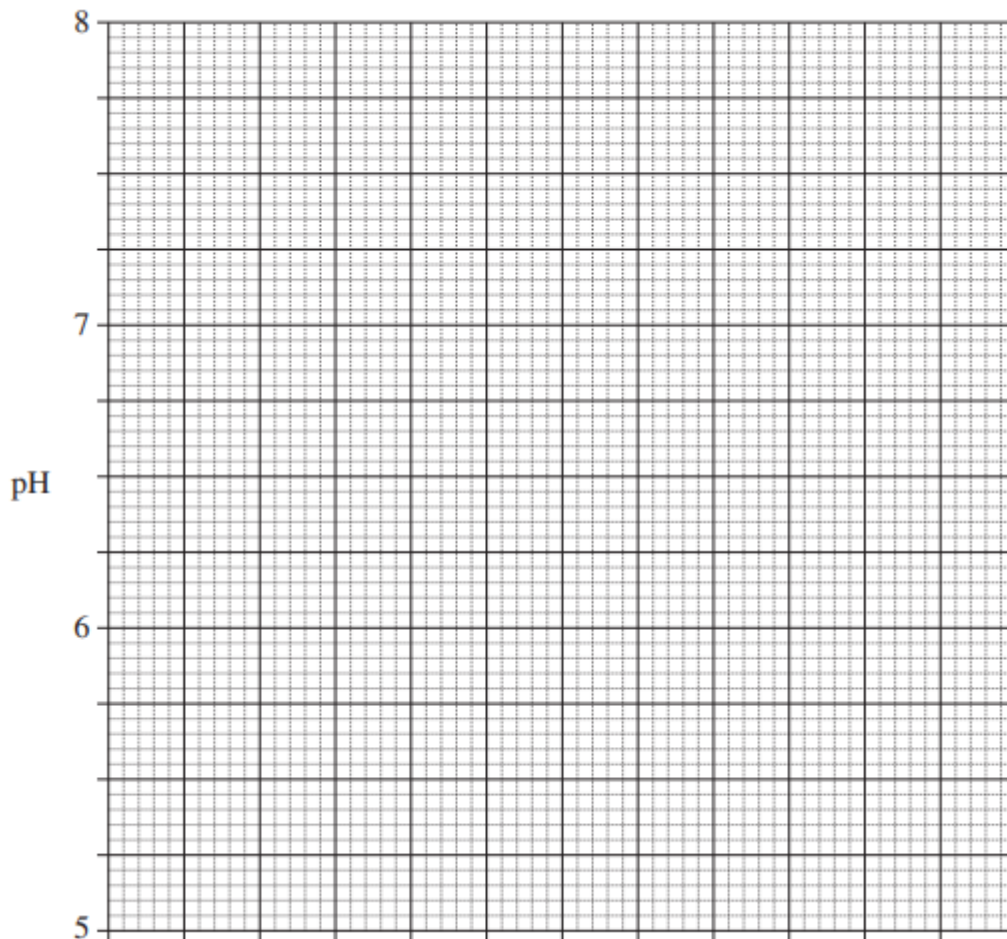


(a) Present these data in a table in the space below.

2

(b) On the grid below, plot the data from the table in part (a) and draw a line of best fit.

3



(c) Why is it better to represent these results as a line of best fit rather than as a column graph? 2

Question 23 (5 marks)

In your course, you conducted a first-hand investigation on factors affecting the rate of transpiration.

- (a) Identify TWO safe work practices needed during this investigation. **2**

- (b) List THREE pieces of equipment or resources you used for that investigation and justify the use of each. **3**

Question 25 (5 marks)

There are many lines of evidence that support the theory of biological evolution. One of these is the existence of transitional forms.

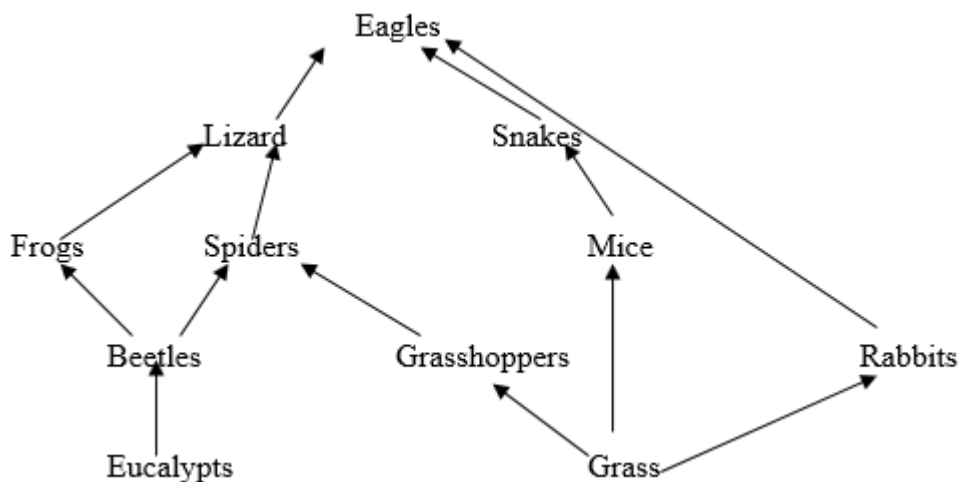
(a) What is a transitional form? **1**

(b) How do transitional forms provide evidence for the theory of biological evolution? **2**

(c) Name ONE example of a transitional form, and name the TWO groups of organisms between which it is transitional. **2**

Question 26 (4 marks)

Refer to the information shown in the food web below to answer the following questions.



(a) Describe the effect of increase in grasshopper population on this ecosystem.

2

(b) Identify the important group of organisms that are not included in this food web and explain their significance.

2

Question 27 (6 marks)

Construct a table in the space below to compare the processes of movement of materials in xylem and phloem in a plant.

6

Question 28 is on next page

Question 28 (3 marks)

Complete the table below to illustrate the hierarchical way in which structures in multicellular organisms can be organised.

Give one example of a structure at each level of organisation.

3

Organ system	
Organ (belonging to the above system)	
Tissue (found in the organ above)	
Cell (found in the tissue above)	
Organelle (found in the cell above)	

Question 29 (4 marks)

Compare the structures for gaseous exchange in a frog and a mammal.

4

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Question 30 (6 marks)

In order to determine the population density of ants in the bush reserve, the students chose four, 1 m² quadrats, close to the walking track, and easy to work in.

They captured and counted all the ants from the surface of each 1 m² quadrat, and their results are shown below.

Quadrat number	Number of ants
1	4
2	0
3	128
4	18
5	0

a) Use their results to determine the population density of ants.

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1

b) Evaluate the procedure followed by the students.

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3

c) Suggest a more suitable sampling technique and justify your suggestion.

2

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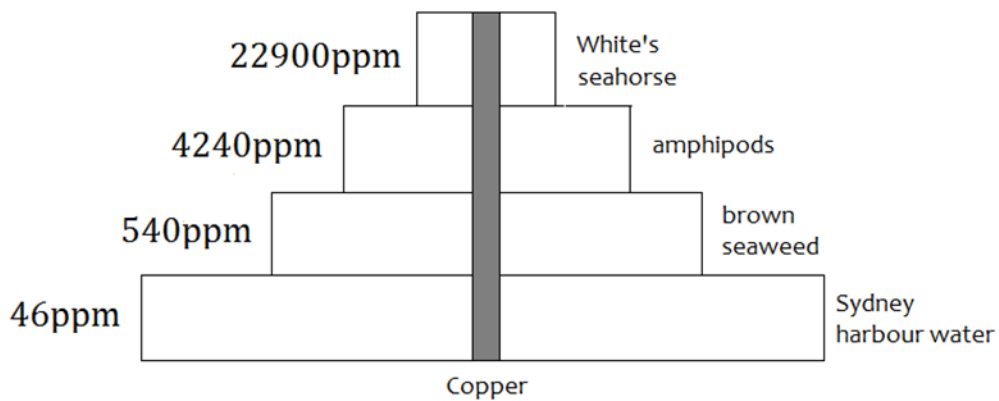
Question 31 appears on the next page

Question 31 (4 marks)

Copper is essential for optimum biological function, but only in minute amounts. Any excessive Copper ingested by organisms is not metabolised and accumulates in the living tissue instead.

Biomagnification or **bioaccumulation** is the increase in concentration of substances (such as Copper) at each level of an ecosystem. The pyramid below shows the relative concentrations of non-metabolised Copper within the aquatic ecosystem of the Sydney Harbour.

(Note: ppm = parts per million parts)



a) Calculate how much the concentration of Copper has increased by the time it is taken up into the living tissue of the White's seahorse population.

1

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b) Copper concentrations of above approximately 18000ppm are toxic enough to result in very high mortality rates in marine organisms.

Explain what would happen to these organisms of Sydney Harbour as a result of Copper biomagnification.

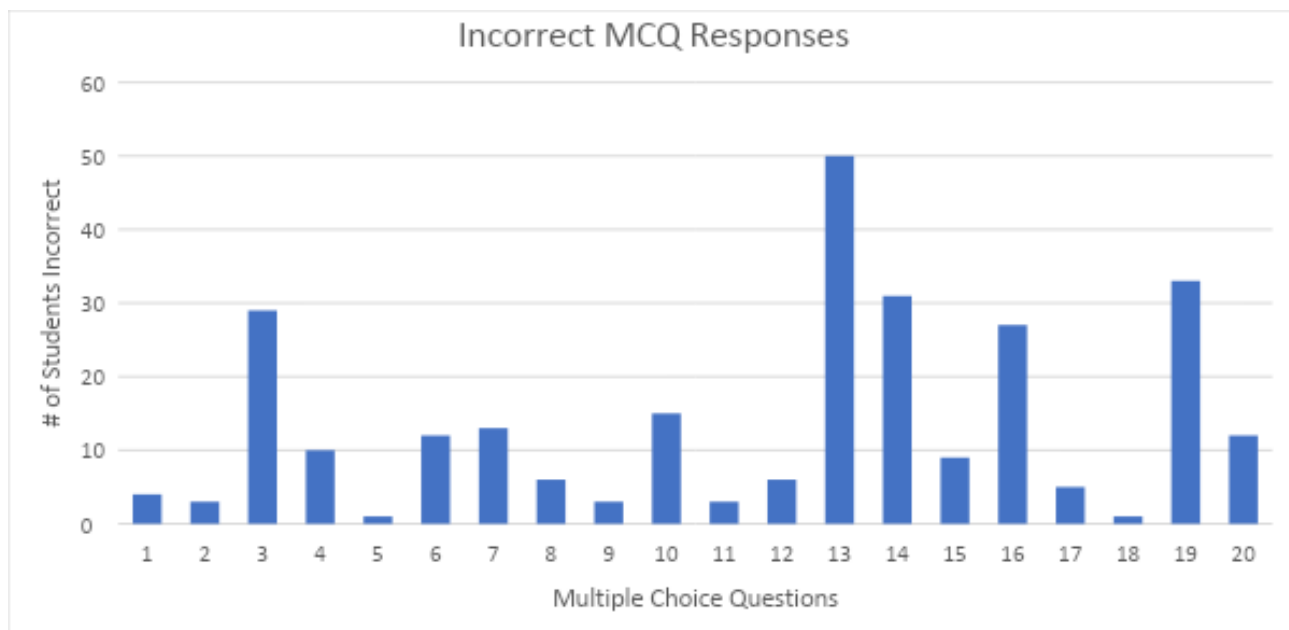
3

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A series of 30 horizontal dotted lines spanning the width of the page, intended for writing or drawing.

Marking criteria

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
D	A	A	A	B	D	C	C	B	C	D	D	A	D	A	A	B	B	D	C



MCQ13 was particularly problematic. Most students picked C, because they mixed up the radioisotope with its decay product. Some students picked B, because they mixed up the order of rock layers (the younger/shallower rock layer contained the fossil).

Question 21

(a)

Criteria	Marks
• Constructs a table that includes ALL of the following: headings, units and ordered data	2
• Constructs a table that includes TWO of the following: headings, units and ordered data	1

(b)

Criteria	Marks
• Includes ALL of the following: X-axis correctly labelled; scaled (linear); points plotted correctly from data table; curve of best fit correct	3
• Includes any THREE of the above	2
• Includes any ONE of the above	1

(c)

Criteria	Marks
• States that the independent variable is continuous, and not linear	2
• States ONE of the above	1

Question 22

Criteria	Mark
Thoroughly analyses and explains the results of the experiment referring to the data including <ul style="list-style-type: none">the average is calculated not using Trial 4 result and refers to the deliberate exclusion of the Trial 4 result from the average calculationRelates increase in CO₂ to decrease in pH and an increase in enzyme activityRelates observable changes in the activity of this enzyme to optimal pH of an enzymeObserves rate of increase of enzyme activity slows down for the larger volumes of CO₂Engages appropriately with the data at 300 bubbles of CO₂	5
Analyses the results of the experiment (missing one from above)	4
Explains the results of the experiment	3
Describes the results of the experiment	2
Identifies the trend in the result of the experiment	1

Sample answer:

Before averaging the data at 300 bubbles of CO₂, the outlier (311 seconds) was removed. This was necessary as it is significantly different to other values for time taken to curdle at that CO₂ volume.

One trend observable in the results is that as bubbles of CO₂ in the milk samples increase, the time taken to curdle decreases. This means that the concentration of CO₂ increases activity of the enzyme.

After 200 bubbles of CO₂ have been added the rate of increase of enzyme activity decreases with addition of further CO₂. As CO₂ is added to a solution it becomes more and more acidic.

The slower increase of enzyme activity after 250 bubbles of CO₂ is due to the enzyme being close to its optimum pH where the enzyme activity graph flattens off at the peak of the curve.

The enzyme activity is similar at 250 bubbles and 300 bubbles of CO₂

Question 23 (a)

Criteria	Marks
Identifies 2 work practices	2
Identifies 1 work practice	1

(b)

Criteria	Marks
Lists and justifies the use of 3 pieces of equipment	3
2 equipment	2
1 equipment	1

Question 24

Syllabus content, outcomes, targeted performance bands and marking guide

<p>Charles Darwin observed many unique organisms on his voyages and saw that similar ecological niches in different parts of the world are occupied by very different species.</p> <p>In his study of finches on the Galapagos Islands, Darwin found an example to explain his Theory of Evolution by Natural Selection. Darwin proposed this theory based on key principles.</p> <p>variation: Inheritable variation exists within a population. Darwin observed a variety of different phenotypes of finches across different islands in the Galapagos group. One variation was related to the beaks of the finches, which ranged from long and thin, to short, thick and strong.</p> <p>production: More organisms are produced than will survive. Darwin proposed that many organisms who compete for resources are born and not all organisms will survive.</p> <p>uggle for survival: Offspring compete. Darwin proposed that differently shaped beaks enabled the finches to feed on specific foods unique to the different Galapagos islands, such as cactus plants, hard seeds or nectar. Individuals competed for resources, including food.</p> <p>rvival of the most adapted: Darwin proposed that the finches with beaks that were most able to help them feed on the resources on each island survived over birds that were not as adapted. The birds with better adapted beaks went on to reproduce, so the offspring inherited the same beak as the parent. The birds that did not survive did not reproduce. Thus, the finch population changed or evolved over time to have the favoured phenotype for the specific food resource on each individual island.</p> <p>: Responses could also refer to other organisms Darwin studied, such as the Galapagos tortoise, the rat-kangaroo or the platypus.</p>	<p>Mod 3 Biological Diversity BIO11–7, 11–10 Bands 1–6</p> <p>Relates Darwin’s observations to the development of the Theory of Evolution by Natural Selection.</p> <p>AND</p> <p>Shows a detailed understanding of the key principles of the Theory of Evolution by Natural Selection.</p> <p>AND</p> <p>Refers to ONE organism Darwin studied from the Galapagos Islands OR Australia. 5–6</p> <p>Relates Darwin’s observations to the development of the Theory of Evolution by Natural Selection.</p> <p>AND</p> <p>Shows understanding of the key principles of the Theory of Evolution by Natural Selection.</p> <p>OR</p> <p>Refers to ONE organism Darwin studied from the Galapagos Islands OR Australia. 3–4</p> <p>Relates Darwin’s observations to the development of the Theory of Evolution by Natural Selection.</p> <p>OR</p> <p>Shows understanding of the key principles of the Theory of Evolution by Natural Selection.</p> <p>OR</p> <p>Refers to ONE organism Darwin studied from the Galapagos Islands OR Australia 2</p> <p>Provides some relevant information 1</p>
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Question 25

(a)

Criteria	Marks
Defines what is transitional form	1

An organism that is intermediate between two different species.

(b)

Criteria	Marks
Describes how transitional forms provide evidence	2
Identifies or basic description of the transitional form to evolution	1

Shows how a species has changed from one major group into another over time due to adaptation in response to environmental changes.

(c)

Criteria	Marks
Name of a transitional form and the two groups	2
Either name of the transitional form OR the two groups	1

Archaeopteryx – reptile and bird

Platypus – reptile and mammal

Question 26

(a)

Criteria	Marks
Describes the effect in two - three or more organisms	2
Brief or basic description of the effect	1

(b)

Criteria	Marks
Name of the group of organisms and it's role	2
Any one of the above	1

Question 27

Compare – Similarity and difference

Criteria	Marks
<ul style="list-style-type: none">- Scientific format used to draw the table – closed borders, column heading, rows with appropriate headings- Similarities and differences between the movement of materials in the xylem and phloem- Similarity both transport materials inside the plant and are tube like.- Xylem transports water and dissolved minerals while phloem transports sucrose.- Movement in xylem is upwards and in phloem is both up and down.- Xylem is a dead hollow tube while phloem is living with sieve plates. At least 1 - 2 similarities and 3 – 4 differences	6
<ul style="list-style-type: none">- Table not drawn using scientific format OR missing a similarity OR a difference	5
<ul style="list-style-type: none">- Any two missing	4
<ul style="list-style-type: none">- Any 3 missing	3
<ul style="list-style-type: none">- Any 3 missing	2
<ul style="list-style-type: none">- Brief description only	1

Question 28

Criteria	Marks
<ul style="list-style-type: none">- Correctly identifies the hierarchical way in which structures in multicellular organisms are organised.	3
<ul style="list-style-type: none">- Missing one	2
<ul style="list-style-type: none">- Missing Two OR Three	1

Question 29

Criteria	Marks
Student response: <ul style="list-style-type: none">Makes at least 4 explicit comparisons including (at least one similarity AND at least one difference)	4
<ul style="list-style-type: none">Makes at least 3 explicit comparisons includingat least one similarity OR at least one difference	3
<ul style="list-style-type: none">Makes at least 2 explicit comparisons OR describes both categories separately	2
<ul style="list-style-type: none">Provides some relevant information	1

Question 30(a)

Criteria	Marks
Student correctly determines a population density of 30 ants/m ² (no working out needed)	1

Question 30(b)

Criteria	Marks
Student response: <ul style="list-style-type: none">Describes at least one positive feature of the procedure, linking it to validity, reliability, accuracy or a safety issueDescribes at least one negative feature of the procedure, linking it to validity, reliability, accuracy or a safety issueProvides a clear judgement statement	3
Response is limited or missing in one of the above aspects	2
Response is limited or missing in two of the above aspects	1

Question 30(c)

Criteria	Marks
Student correctly identifies a more suitable sampling technique, and provides at least one linked justification (ideally capture-mark-recapture)	2
Justification is limited in some way	1

Question 31(a)

Criteria	Marks
Student shows working for a correct magnification factor of $\sim x498$	1

Answers may include:

$\approx 498x$

Concentrations of copper increase by a factor of 498.

Increased by 22854ppm.

$\approx 49782\%$

(Note: question did not specify units so potential answers vary).

(Note2: If students did not show working but had a correct answers they still got 0 as the question was worth 1

mark. The question asked for students to calculate, if they did not show calculations they were not answering)

Question 31(b)

Criteria	Marks
Student provides one cause, one initial effect AND one consequential effect explicitly linked to the first.	3
Student response includes one cause and one linked effect	2
Student identifies one relevant effect	1

Answers may include:

(3 marks) The White's seahorse population will decrease significantly because copper concentrations accumulate in their living tissue to 22900ppm, which is above the highly toxic levels of 18000ppm. The population of amphipods in Sydney Harbour will then increase because the abundance of their predators has been decreased.

(2 marks) The White's seahorse population will decrease significantly because copper concentrations accumulate in their living tissue to 22900ppm, which is above the highly toxic levels of 18000ppm.

(1 mark) The White's seahorse population will decrease significantly.