1. A prokaryotic cell contains which of the following organelles?

   A. Nucleus

   B. Vacuole

   C. Ribosomes

   D. Endoplasmic reticulum

2. Which alternative correctly identifies the tissues that transport carbohydrates in these organisms?

	Plant	*Animal*
A.	Phloem	Blood
B.	Phloem	Lymph
C.	Xylem	Blood
D.	Xylem	Lymph

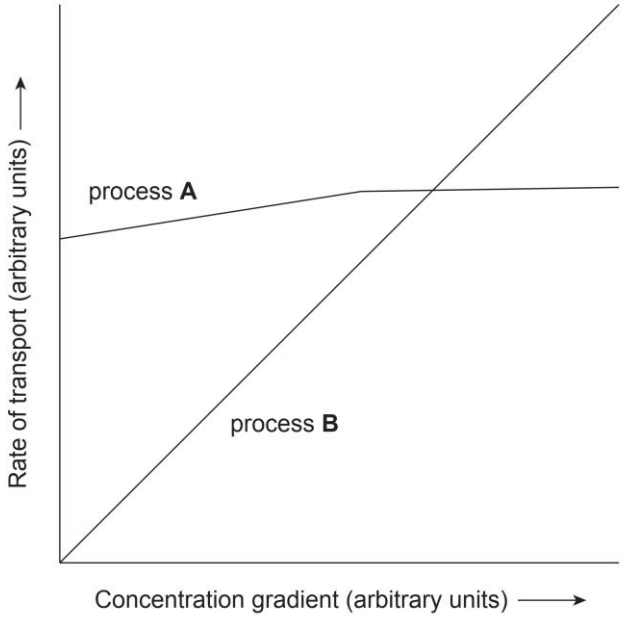
3. A partial chemical equation showing a process that occurs in cells is shown.

$$C_6H_{12}O_6 + 6O_2 \longrightarrow \text{product(s)}$$

   Which combination identifies the product(s) formed and type of cell that produces the product(s)?

	Product(s)	*Type of cell*
A.	Lactic acid	Animal
B.	Water and carbon dioxide	Plant
C.	Ethanol and carbon dioxide	Animal
D.	Lactic acid and carbon dioxide	Plant

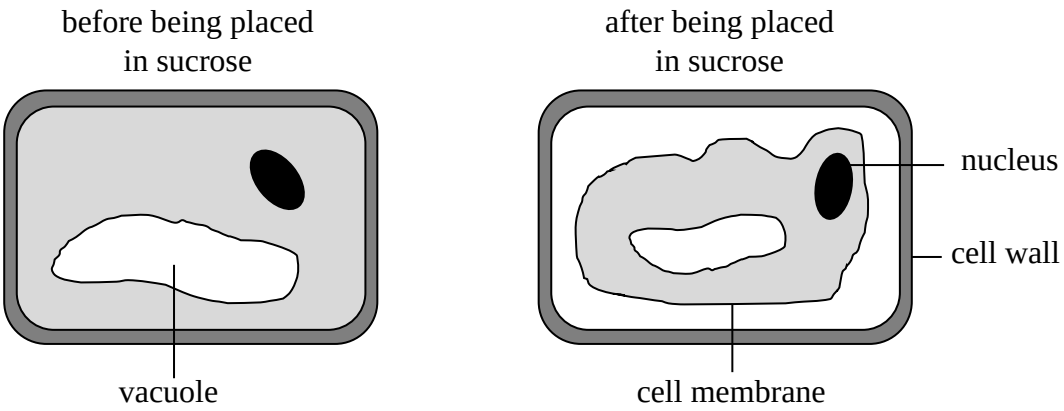
4. The following graph shows the relationship between the concentration gradient of a substance and the rate of its transport across a cell membrane by two different processes, A and B.



Based on the information shown on the graph, the types of transport shown as A and B are:

	Process A	*Process B*
A.	Active	Active
B.	Active	Passive
C.	Passive	Active
D.	Passive	Passive

5. A plant cell was placed in a sucrose solution and changes within the cell were observed and drawn.



From the information shown, what conclusion can be made about the cell whilst it was in the sucrose solution?

A. The cell was hypotonic.

B. The cell was hypertonic.

C. The cell wall was impermeable to water molecules.

D. The sucrose molecules passed through the cell membrane.

6. Which of the following statements describes a process that requires the expenditure of cellular energy?

A. The movement of water from the nephron into the renal capillaries.

B. The movement of water from the soil into the root hair cells of a plant.

C. The movement of sucrose from the source into the phloem sieve tubes.

D. The movement of oxygen from the alveoli into the pulmonary capillaries.

7. Radioactive tracers can be used to investigate biochemical pathways in living systems. Oxygen-18 (O^{18}) is an isotope used to investigate biochemical processes in plants. When O^{18}-enriched water (H_2O^{18}) is used in photosynthesis, a $O^{18}{}_2$ molecule is produced.

What conclusion can be made from the evidence obtained?

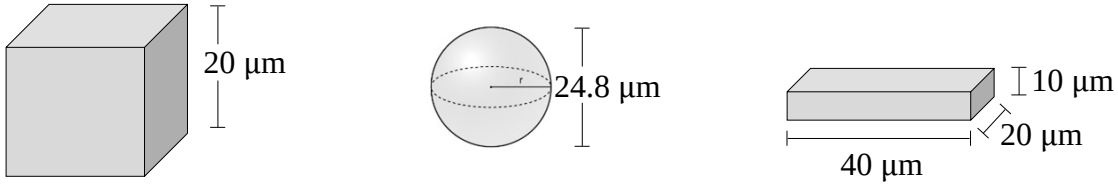
A. Glucose is produced using oxygen from water.

B. Glucose is produced using oxygen from carbon dioxide.

C. Glucose is produced using oxygen absorbed from the roots.

D. Glucose is produced using oxygen from cellular respiration.

8. A, B and C model cells of different size and shape (diagrams are not to scale).



A B C

V for all three shapes = 8000 μm^3

Which of the following statements identifies the relative efficiency of these cells in the exchange of materials?

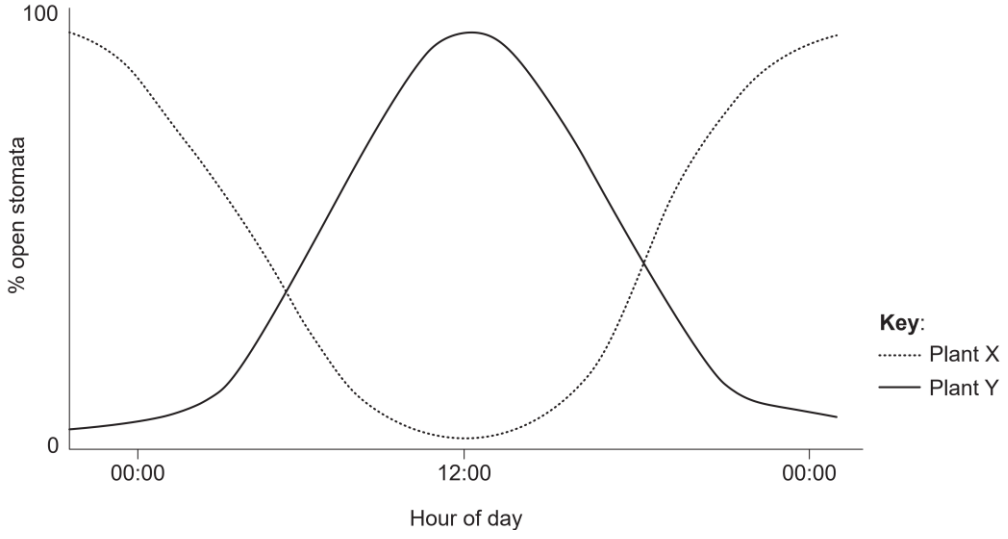
A. Cell A is more efficient than cell B and cell C.

B. Cell B is more efficient than cell A and cell C.

C. Cell C is more efficient than cell A and cell B.

D. Cell B is more efficient than cell A but less efficient than cell C.

9. The graph shows the percentage of stomata that are open in two different species of plant over a 24-hour period.



What does this graph show about plants X and Y?

A. Plant Y only respires during the day.

B. Plant X is adapted to desert conditions.

C. Plant X photosynthesises most at midday.

D. Plant Y absorbs most carbon dioxide at night.

10. Yeast cells supplied with glucose are moved from an aerobic environment to an anaerobic environment.

    Which of the following outlines the change in the amount of energy released by the yeast cells?

    A. Less energy is released in the aerobic environment than in the anaerobic environment.

    B. More energy is released in the aerobic environment than in the anaerobic environment.

    C. More energy is released in the anaerobic environment than in the aerobic environment.

    D. The same energy is released in the anaerobic environment than in aerobic environment.

11. During pulmonary respiration in terrestrial vertebrates, carbon dioxide diffuses from the blood across the alveolus and into the lungs. Which factor increases the diffusion rate of carbon dioxide?

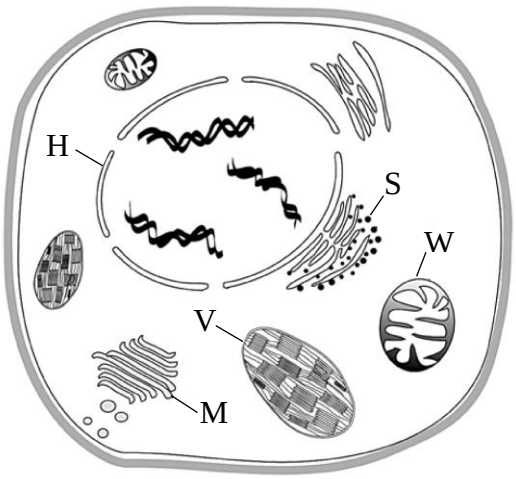
    A. A higher concentration of oxygen in the blood compared to the lungs.

    B. A higher concentration of oxygen in the lungs compared to the blood.

    C. A higher concentration of carbon dioxide in the blood compared to the lungs.

    D. A higher concentration of carbon dioxide in the lungs compared to the blood.

12. Consider the following plant cell.



    Identify the process that occurs at structure W.

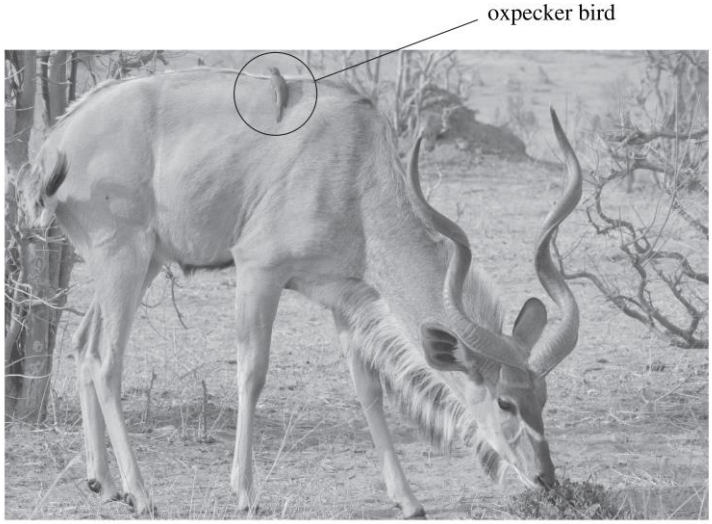
    A. Respiration.

    B. DNA replication

    C. Protein synthesis

    D. Packaging of molecules

13. The photograph shows a kudu (an African antelope) with an oxpecker bird on its back. The kudu feeds on a shrub while the oxpecker feeds on ectoparasites such as ticks that live on the kudu.



Source: Reproduced with permission from Litchfield C (2021), *Kudu and oxpecker bird* [photograph].

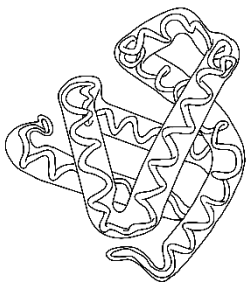
Which row of the table correctly identifies the ecological relationships shown in the photograph?

	Kudu eating shrub	*Oxpecker eating ticks on kudu*	*Ticks living on kudu*
A.	Carnivorism	Commensalism	Predation
B.	Herbivorism	Commensalism	Mutualism
C.	Herbivorism	Mutualism	Parasitism
D.	Predation	Mutualism	Parasitism

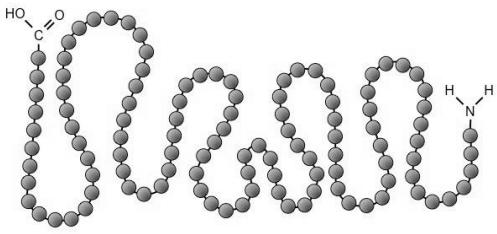
14. Which of the following represents a secondary structure of protein?

A.

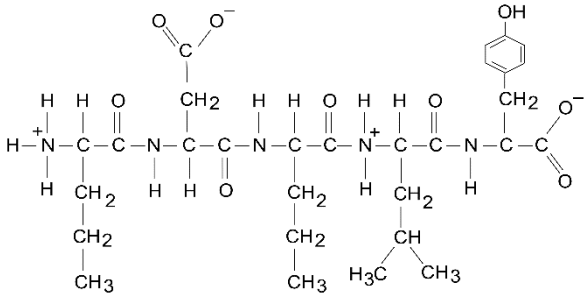
B.



C.



D.

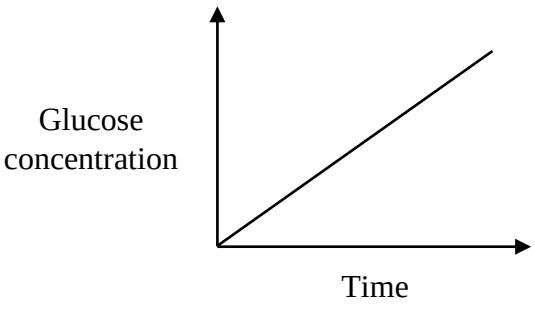


15. The enzyme maltase catalyses the breakdown of maltose into glucose.

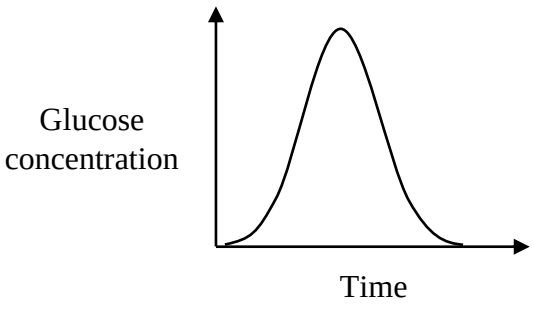
Maltase was added to a tube containing a solution of maltose in water and incubated at 37°C. The amount of glucose produced was monitored over a period of time. No maltose remained at the end.

Which of the graphs below shows the change in the glucose concentration in the tube?

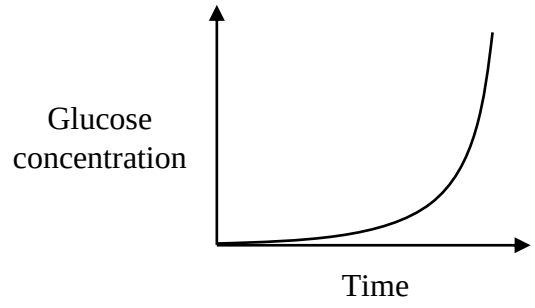
A.



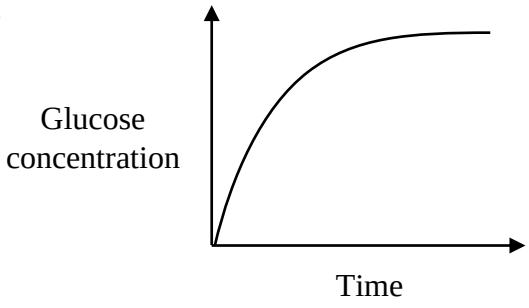
B.



C.



D.



16. A researcher discovered an organism with cells that contain a previously undescribed organelle. He performed tests on the isolated organelle to see if it is involved in any major metabolic reactions. The researcher incubated these organelles for a period of time in a solution containing a known amount of the molecules listed in the table below and measured changes in these amounts in the suspending solution.

Substance	*Change in concentration*
Glucose	No change
O_2	Increase
CO_2	No change
ATP	Increase
NADPH	Increase

Based on these results, which metabolic process is most likely to be taking place in this organelle?

A. Glycolysis

B. Calvin cycle

C. Citric acid (Krebs) cycle

D. Light-dependent reaction of photosynthesis

17. Biologists have long proposed that reptiles evolved from fish-like ancestors. In 2004, a 375 million year-old fossil fish (*Tiktaaklik roseae*) was found in Nunavut, Canada. This fossil had fins, scales and gills like a fish but had a crocodile-like skull, a moveable neck and forelimb bones resembling those of early reptiles.

The *Tiktaalik* fossil provides what type of evidence between fish and crocodiles?

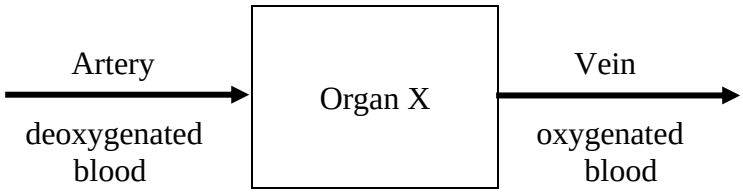
A. Coevolution.

B. An index fossil.

C. A transitional fossil.

D. Convergent evolution.

18. The diagram below shows the difference in composition of blood as it enters and leaves an organ.



What is organ X?

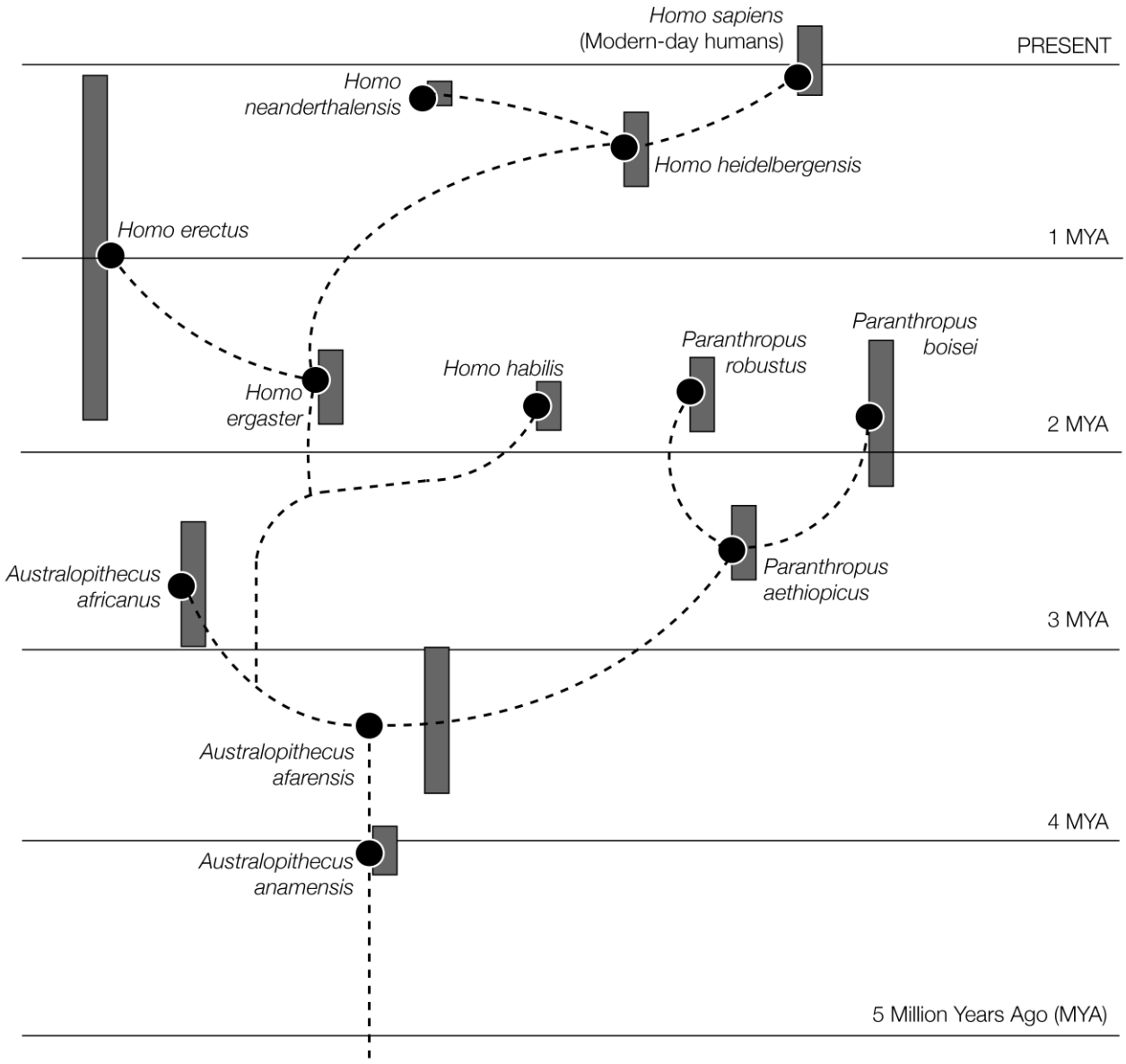
A. Brain

B. Heart

C. Kidneys

D. Lungs

19. The diagram below illustrates one interpretation of the origin of humans. The dotted lines indicate possible evolutionary relationships, and the vertical bars show the period from which fossils are known for each species.



Which of the following suggestions is reflected in the data above?

A. *Homo habilis* is an ancestor of modern humans.

B. *Homo sapiens* is descended from *Paranthropus aethiopicus*.

C. *Homo erectus* became extinct before modern humans appeared.

D. *Australopithecus* species may have given rise to modern humans.

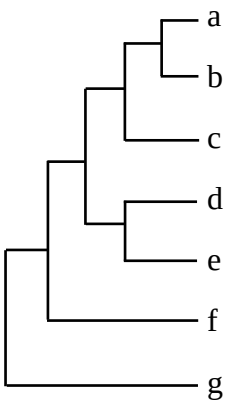
20. The following table shows the number of estimated mutations that have occurred in a gene among seven species.

The number of estimated nucleotide substitution mutations between each pair of species

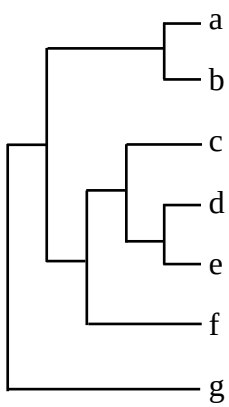
	b	c	d	e	f	g
a	39	72	128	126	159	269
b		81	130	128	158	268
c			129	127	157	267
d				56	154	271
e					151	268
f						273

Which is the most appropriate tree that shows the phylogenetic relationship among these seven species?

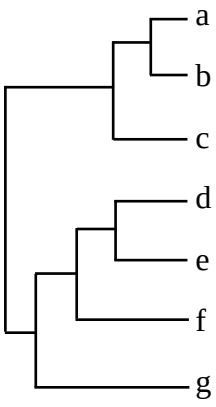
A.



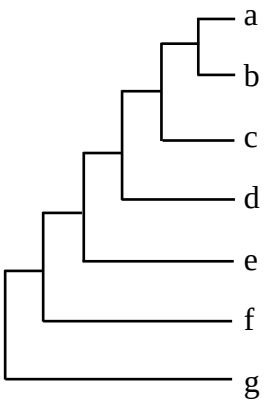
B.



C.



D.



End of Section I

Question 21 (7 marks)

The micrograph shows a cross section of a plant organ.

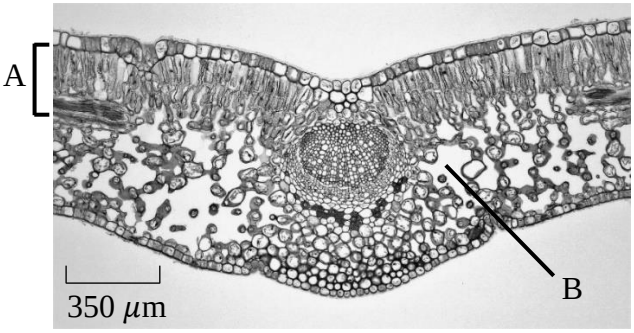


Figure 1

a) Identify the structures labelled as A and B. **2**

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The image below shows a micrograph image of a plant organelle.

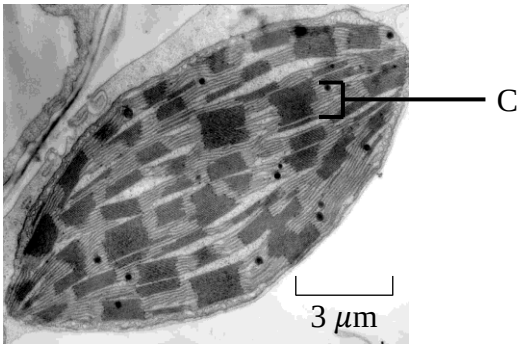


Figure 2

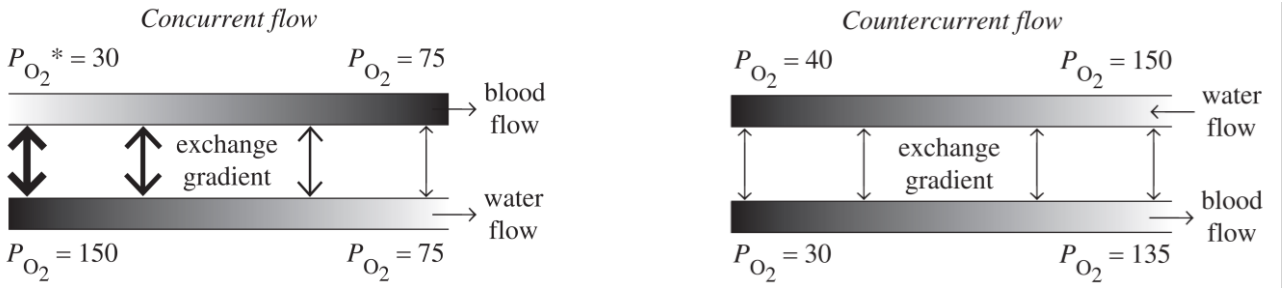
b) Identify the structure labelled as C. **1**

……

c) Draw a table to contrast between the technologies used to obtain the micrograph images shown in Figures 1 and 2. **4**

Question 22 (5 marks)

Countercurrent exchange mechanisms are used for a variety of reasons in living organisms. The diagram shows the concurrent and countercurrent flows in the gills of a fish.



*P_{O_2} refers to the partial pressure (concentration) of oxygen.

a) Explain why a fish benefits from a countercurrent flow across a lamella in its gills compared to concurrent flow. **2**

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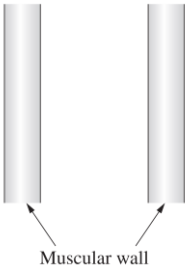
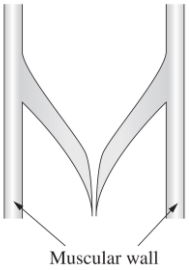
Fish have the simplest (closed) circulatory systems of all vertebrates. Two types of blood vessels that can be found in fish are shown below.

b) Complete the table with reference to the two types of blood vessels. **3**

Diagram of vessel		
Name of the vessel	……	……
Explain how ONE structural feature of the vessel enables it to carry out its function	…… …… …… …… ……	…… …… …… …… ……

Question 23 (5 marks)

In 2012, a fennec fox, not native to Australia, named Zahra was born at Taronga Zoo. In 2019, Zahra was moved to Adelaide Zoo where she is a favourite with visitors. Fennec foxes are nocturnal and visitors to Adelaide Zoo can often find Zahra snoozing during the day in her cave under heat lamps or finding a cool spot under the rocks in summer. A picture of a fennec fox with her keeper is shown.

a) Predict the type of biome and climate conditions observed in the native habitat of fennec foxes. **2**

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b) Describe two distinct types of adaptations that can be observed in fennec foxes to allow them to survive in their natural habitat. **3**

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Question 24 (8 marks)

a) Describe the function of a stomate. **2**

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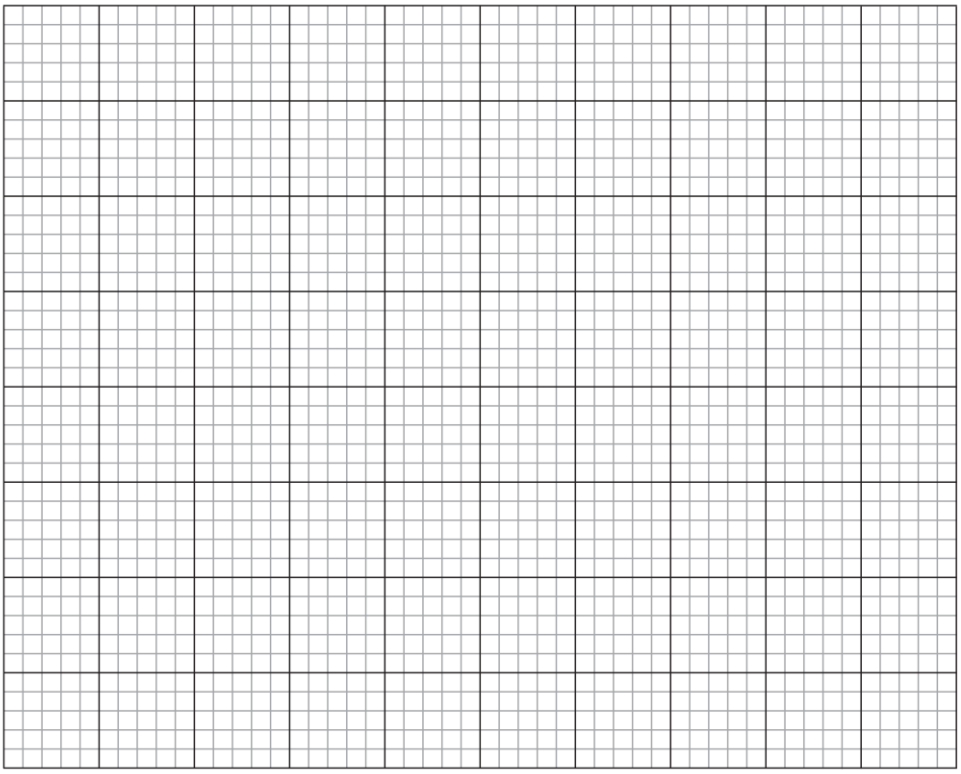
Scientists compared the density of stomates of a variety of plants from different environments. The results are shown in the table.

Plant variety	*Stomatal density (mm^2)*
Daisy leaf (*Bellis perennis*)	100
Squash leaf (*Cucurbita argyrosperma*)	185
Zucchini leaf (*Cucurbita pepo*)	198
Cowhorn agave tissue (*Agave bovicornuta*)	8
Christmas cactus tissue (*Schlumbergera russelliana*)	17

b) Graph the data on the grid. **3**



Question 14 continues on the next page

Question 24 *continued*

c) Determine which plants shown by the data are adapted to a desert environment. Justify your answer. **3**

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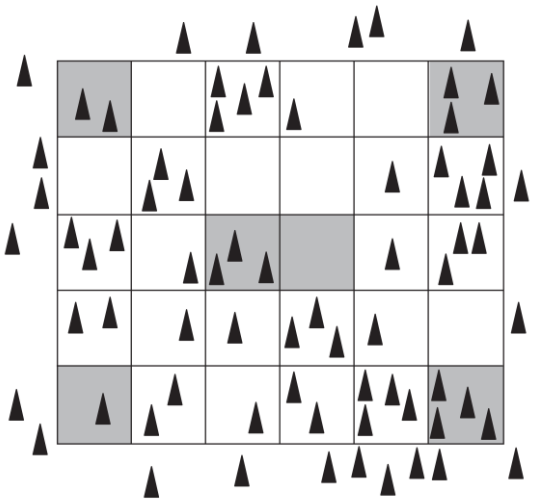
Question 25 (3 marks)

The diagram represents a population of pine trees in a forest. Randomly selected quadrats have been shaded and each quadrat is 10 m^2.



a) Use the shaded quadrats to estimate the total population of pine trees in the marked area of the forest. Show your working. **2**

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b) Outline one way to improve your estimate in part (a). **1**

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Question 26 (4 marks)

The diagrams below represent part of the human breathing system.

Diagram A

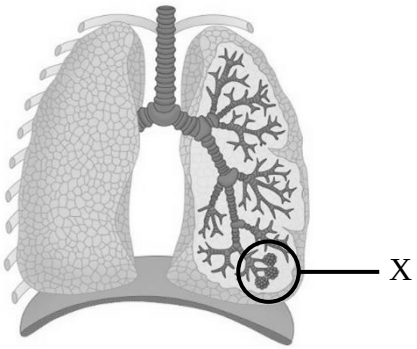
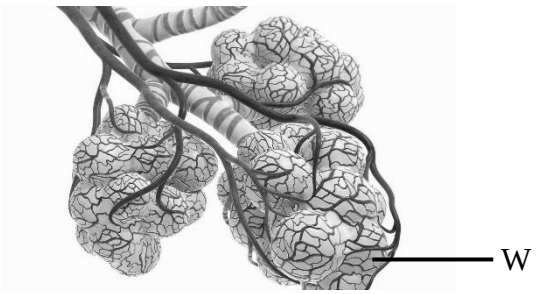


Diagram B
(This is a magnified view of X)



a) Describe two features of the Structure W which improve the efficiency of gas exchange. **2**

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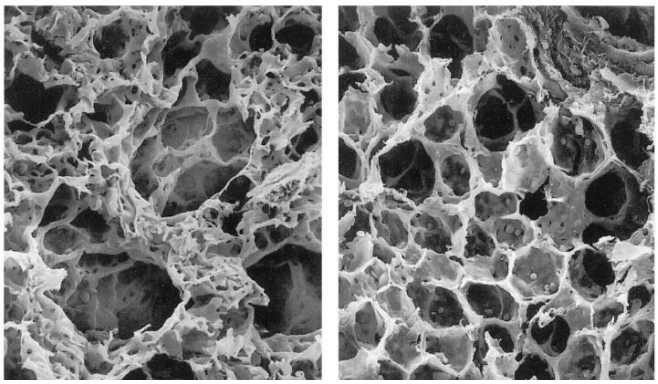
Research suggests that exposure to second-hand smoke may cause an elevated risk of developing chronic obstructive pulmonary disease (COPD) resulting in reduced lung function that is irreversible. The electron micrographs below show the alveoli of a person consistently exposed to second-hand smoke for six months and a non-exposed person.



Cigarette smoke exposed Non-smoke Exposed

[source: adapted from researchgate.net]

b) Explain how chronic exposure to second-hand smoke reduces lung function. **2**

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Question 27 (9 marks)

A food chain for organisms in a river and the biomass of the organisms at each trophic level are shown.

Algae → Invertebrate animals → Small fish → Large fish

Biomass in g/m^2:	840	200	40	10

a) Calculate the percentage of the biomass lost between the algae and the large fish. Show your working. **2**

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b) Outline two ways that biomass is lost between trophic levels. **2**

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It is observed that a large amount of untreated sewage entered the river. Many small fish died. Untreated sewage contains organic matter and bacteria.

c) Provide two reasons to explain why many small fish died. **2**

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d) Predict what will happen to the ecosystem of this river as a result of the untreated sewage river dumping. Assuming the large fish do not consume the invertebrate animals as a food source. **3**

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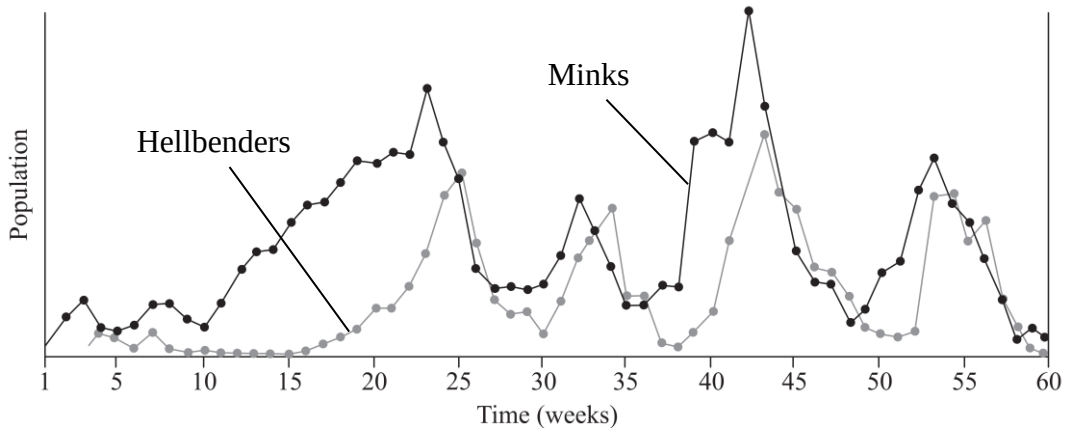
Question 28 (4 marks)

Hellbenders and minks can both be found in regions of North Eastern America. Their activities are observed in the rivers and streams where they are found to share similar ecological niche. The graph below shows the changes in the numbers of hellbenders and minks across a 60-weeks period.



a) Identify the type of relationship in the interactions between the hellbenders and the minks. **1**

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b) Using the data shown in the graph, describe and explain the changes in the populations of the hellbenders and minks. **3**

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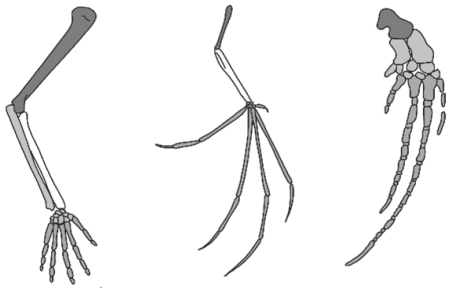
Exam continues on the next page.

Question 29 (4 marks)

Source 1 shows three vertebrate forelimbs. Source 2 shows the wing structure of three flying organisms.

Source 1



Human bat whale

Source 2

Butterfly Bat bird

a) Explain how Sources 1 and 2 can be used as evidence to support the theory of evolution. **4**

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Exam continues on the next page.

Question 30 (6 marks)

The following media release was published on the James Cook University website in May 2023 to highlight a study being carried out by the university that observe urbanisation as an evolutionary force.

> Distinguished Professor Lin Schwarzkopf, Head of Zoology and Ecology at James Cook University, was part of a team that examined how cane toads are changing in cities.
>
> "Urban areas have been expanding rapidly, and this rapid expansion has caused drastic environmental changes over recent decades. Natural habitats, such as parks and gardens, are often isolated from each other by artificial barriers like buildings and roads and this isolation can make evolution quicker." Said Professor Schwarzkopf.
>
> Professor Schwarzkopf said one instance of this was seen in toads.
>
> The team collected more than 400 cane toads from three different sites in north Queensland and measured them.
>
> "We found that the parotoid glands, which are the major anti-predator defence of toads, were smaller in urban than in rural populations. The tibiofibular (a bone in the leg) length of males in urban populations was longer than those in rural populations, but females showed opposite trends," said Professor Schwarzkopf.
>
> "When toads roam around urban areas, they may have to move further in a single trip to overcome barriers such as roads and buildings. Given that male toads tend to move more often than females, males with longer tibiofibular, and therefore better movement ability, may be favoured in urban environments. However, less sedentary females may not experience a similar benefit," …
>
> In any case, the results demonstrate that urbanisation drives the size, shape, and structure of invasive toads, suggesting they may rapidly be adapting to urban environments.

Using your knowledge of Darwin and Wallace's Theory of Evolution by means of Natural Selection, analyse the evolution of the cane toads observed by Professor Schwarzkopf's team. **6**

……..

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More writing space is available on the next page.

Question 30 *continued*

Student Number

Girraween High School

2023 YEAR 11 EXAMINATION

Biology

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used

Total Marks:

75

Section I – 20 marks

- Attempt questions 1–20
- Allow about 30 minutes for this part

Section II – 55 marks

- Attempt questions 21–27
- Allow about 90 minutes for this part

Section I
20 marks

Attempt Questions 1–20
Allow about 30 minutes for this part

Use the multiple-choice answer sheet for Question 1–20.

Select the alternative A, B, C or D that best answers the question. Fill in the response circle 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 this by writing the word *correct* and drawing an arrow as follows:

correct ↘

A ⊗ B ⊗ C ○ D ○

---

1. A prokaryotic cell contains which of the following organelles?

   A. Nucleus

   B. Vacuole

   C. Ribosomes

   D. Endoplasmic reticulum

2. Which alternative correctly identifies the tissues that transport carbohydrates in these organisms?

	Plant	*Animal*
A.	Phloem	Blood
B.	Phloem	Lymph
C.	Xylem	Blood
D.	Xylem	Lymph

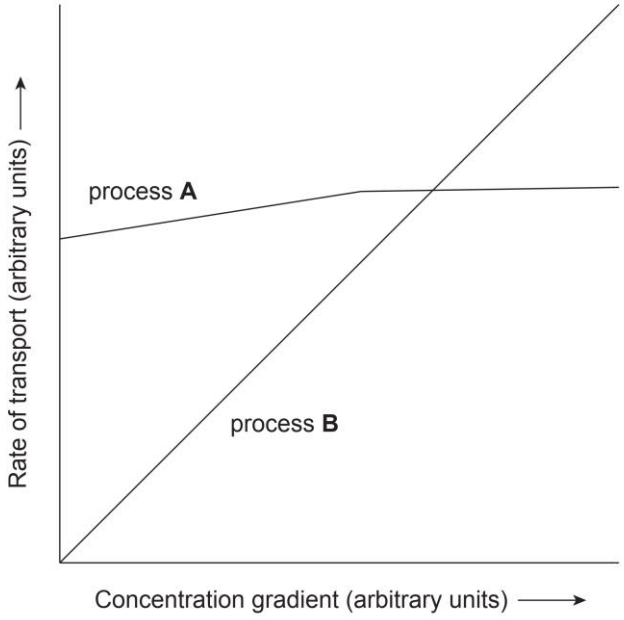
3. A partial chemical equation showing a process that occurs in cells is shown.

$$C_6H_{12}O_6 + 6O_2 \longrightarrow \text{products(s)}$$

Which combination identifies the product(s) formed and type of cell that produces the product(s)?

	Product(s)	*Type of cell*
A.	Lactic acid	Animal
B.	Water and carbon dioxide	Plant
C.	Ethanol and carbon dioxide	Animal
D.	Lactic acid and carbon dioxide	Plant

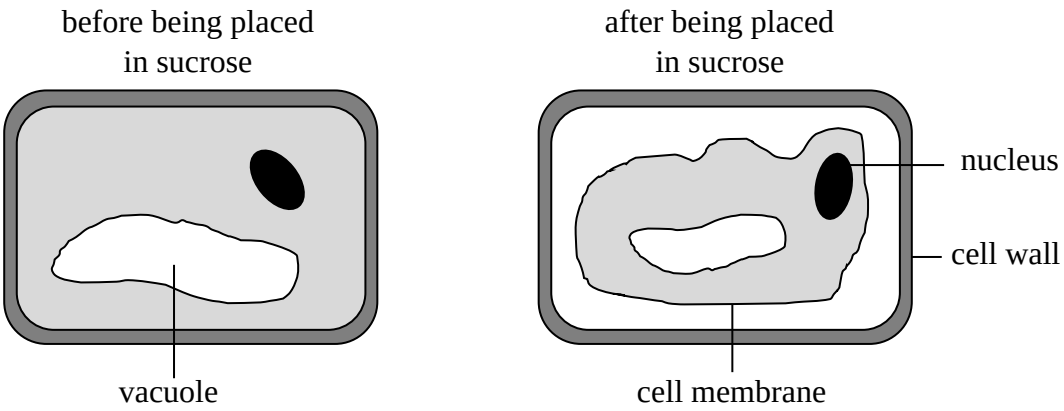
4. The following graph shows the relationship between the concentration gradient of a substance and the rate of its transport across a cell membrane by two different processes, A and B.



Based on the information shown on the graph, the types of transport shown as A and B are:

	Process A	*Process B*
A.	Active	Active
B.	Active	Passive
C.	Passive	Active
D.	Passive	Passive

5. A plant cell was placed in a sucrose solution and changes within the cell were observed and drawn.



From the information shown, what conclusion can be made while the cell was in the sucrose solution?

A. The cell was hypotonic.

B. The cell was hypertonic.

C. The cell wall was impermeable to water molecules.

D. The sucrose molecules passed through the cell membrane.

6. Which of the following statements describes a process that requires the expenditure of cellular energy?

A. The movement of water from the nephron into the renal capillaries.

B. The movement of water from the soil into the root hair cells of a plant.

C. The movement of sucrose from the source into the phloem sieve tubes.

D. The movement of oxygen from the alveoli into the pulmonary capillaries.

7. Radioactive tracers can be used to investigate biochemical pathways in living systems. Oxygen-18 (O^{18}) is an isotope used to investigate biochemical processes in plants. When O^{18}-enriched water (H_2O^{18}) is used in photosynthesis, a O^{18}_2 molecule is produced.

What conclusion can be made from the evidence obtained?

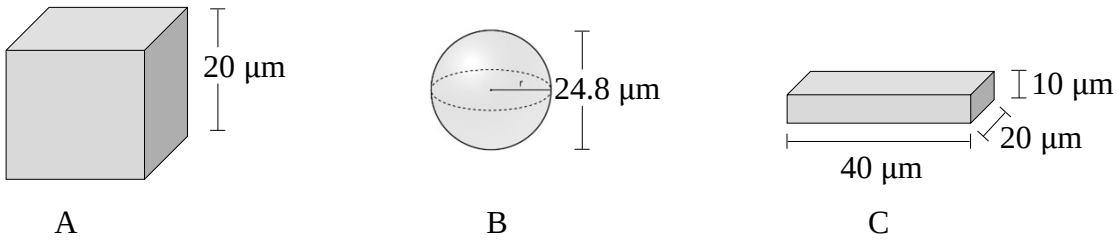
A. Glucose is produced using oxygen from water.

B. Glucose is produced using oxygen from carbon dioxide.

C. Glucose is produced using oxygen absorbed from the roots.

D. Glucose is produced using oxygen from cellular respiration.

8. A, B and C model cells of different size and shape (diagrams are not to scale).



Which of the following statements identifies the relative efficiency of these cells in the exchange of materials?

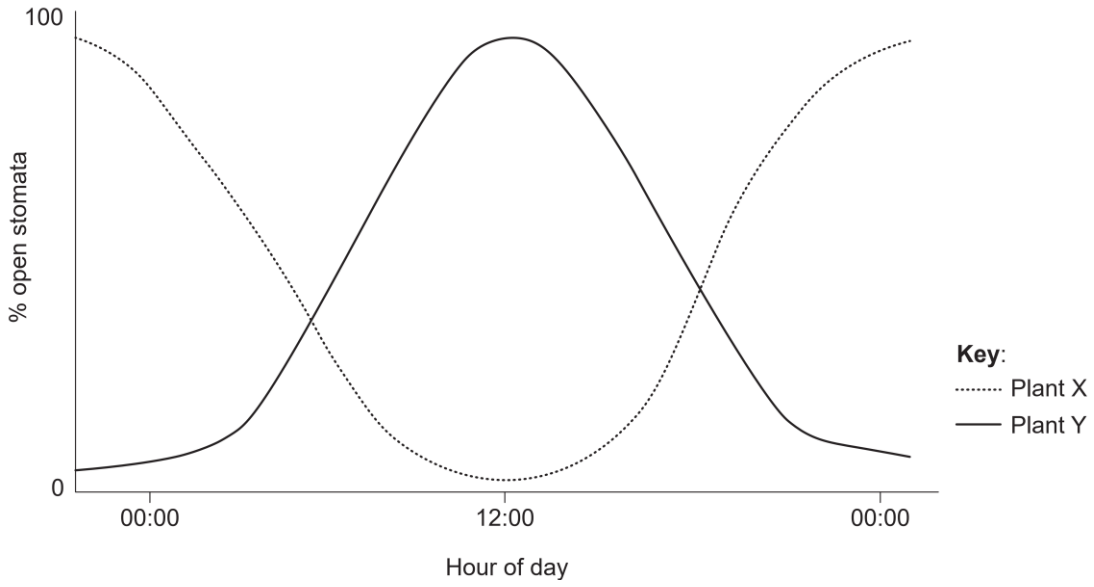
A. Cell A is more efficient than cell B and cell C.

B. Cell B is more efficient than cell A and cell C.

C. Cell C is more efficient than cell A and cell B.

D. Cell B is more efficient than cell A but less efficient than cell C.

9. The graph shows the percentage of stomata that are open in two different species of plant over a 24-hour period.



What does this graph show about plants X and Y?

A. Plant Y only respires during the day.

B. Plant X is adapted to desert conditions.

C. Plant X photosynthesises most at midday.

D. Plant Y absorbs most carbon dioxide at night.

10. Yeast cells supplied with glucose are moved from an aerobic environment to an anaerobic environment.

    Which of the following outlines the change in the amount of energy released by the yeast cells?

    A. Less energy is released in the aerobic environment than in the anaerobic environment.

    B. More energy is released in the aerobic environment than in the anaerobic environment.

    C. More energy is released in the anaerobic environment than in the aerobic environment.

    D. The same energy is released in the anaerobic environment than in aerobic environment.

11. During pulmonary respiration in terrestrial vertebrates, carbon dioxide diffuses from the blood across the alveolus and into the lungs. Which factor increases the diffusion rate of carbon dioxide?

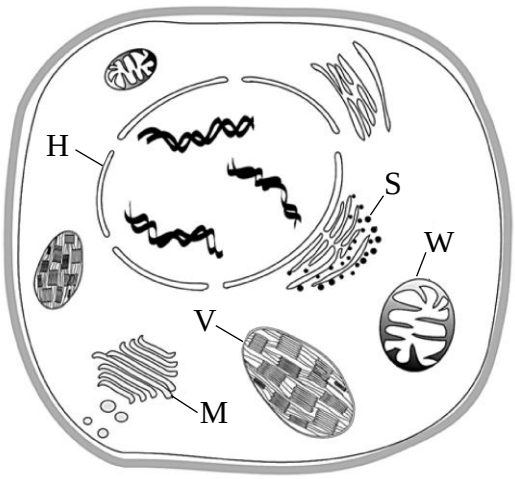
    A. A higher concentration of oxygen in the blood compared to the lungs.

    B. A higher concentration of oxygen in the lungs compared to the blood.

    C. A higher concentration of carbon dioxide in the blood compared to the lungs.

    D. A higher concentration of carbon dioxide in the lungs compared to the blood.

12. Consider the following plant cell.



    Identify the process that occurs at structure W.

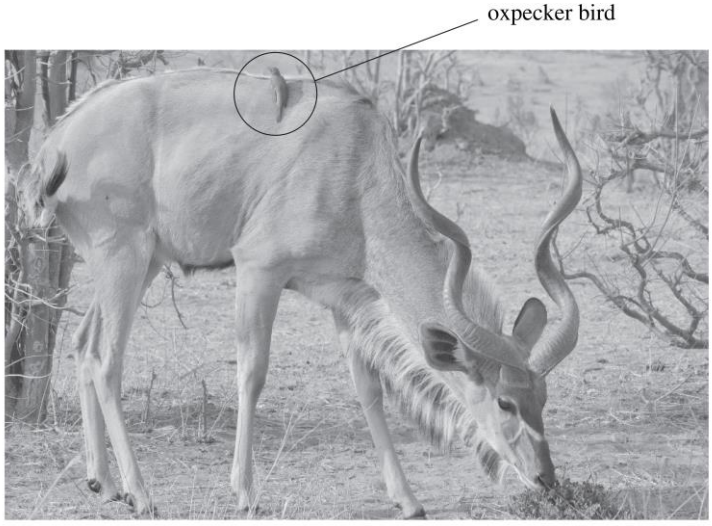
    A. Respiration.

    B. DNA replication

    C. Protein synthesis

    D. Packaging of molecules

13. The photograph shows a kudu (an African antelope) with an oxpecker bird on its back. The kudu feeds on a shrub while the oxpecker feeds on ectoparasites such as ticks that live on the kudu.



Source: Reproduced with permission from Litchfield C (2021), *Kudu and oxpecker bird* [photograph].

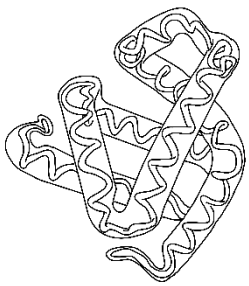
Which row of the table correctly identifies the ecological relationships shown in the photograph?

	Kudu eating shrub	*Oxpecker eating ticks on kudu*	*Ticks living on kudu*
A.	Carnivorism	Commensalism	Predation
B.	Herbivorism	Commensalism	Mutualism
C.	Herbivorism	Mutualism	Parasitism
D.	Predation	Mutualism	Parasitism

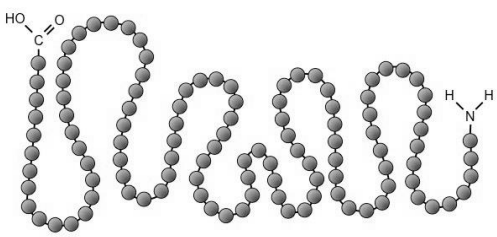
14. Which of the following represents a secondary structure of protein?

A.

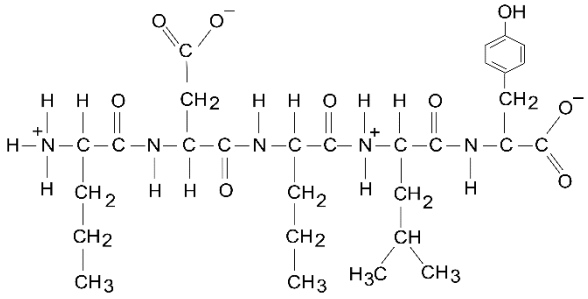
B.



C.



D.

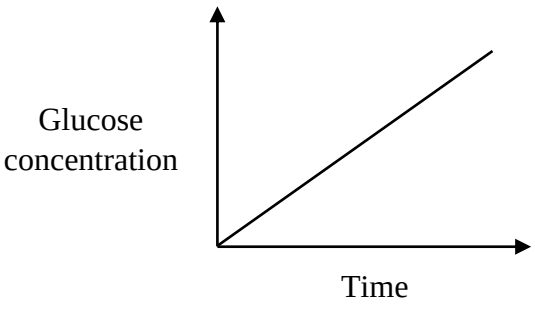


15. The enzyme maltase catalyses the breakdown of maltose into glucose.

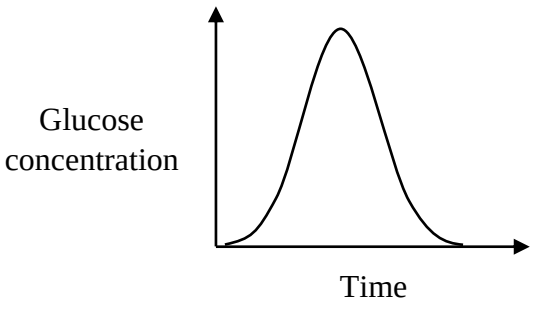
Maltase was added to a tube containing a solution of maltose in water and incubated at 37°C. the amount of glucose produced was monitored over a period of time. No maltose remained at the end.

Which of the graphs below shows the change in the glucose concentration in the tube?

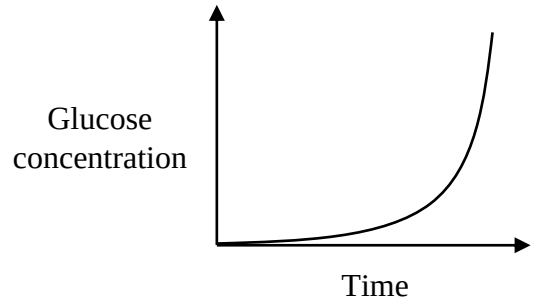
A.



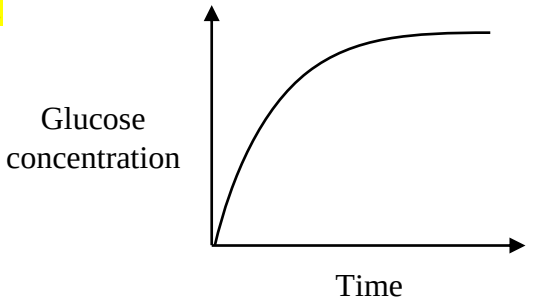
B.



C.



D.



16. A researcher discovered an organism with cells that contain a previously undescribed organelle. He performed tests on the isolated organelle to see if it is involved in any major metabolic reactions. The researcher incubated these organelles for a period of time in a solution containing a known amount of the molecules listed in the table below and measured changes in these amounts in the suspending solution.

Substance	*Change in concentration*
Glucose	No change
O_2	Increase
CO_2	No change
ATP	Increase
NADPH	Increase

Based on these results, which metabolic process is most likely to be taking place in this organelle?

A. Glycolysis

B. Calvin cycle

C. Citric acid (Krebs) cycle

D. Light-dependent reaction of photosynthesis

17. Biologists have long proposed that reptiles evolved from fish-like ancestors. In 2004, a 375 million year-old fossil fish (*Tiktaaklik roseae*) was found in Nunavut, Northern Canada. This fossil had fins, scales and gills like a fish but had a crocodile-like skull, a moveable neck and forelimb bones resembling those of early reptiles.

The *Tiktaalik* fossil provides what type of evidence between fish and crocodiles?

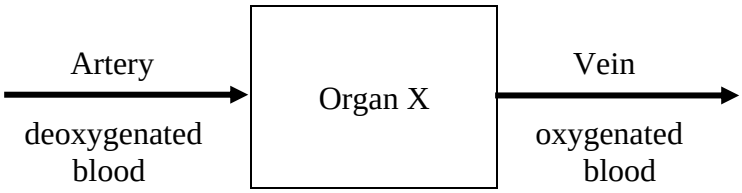
A. Coevolution.

B. An index fossil.

C. A transitional fossil.

D. Convergent evolution.

18. The diagram below shows the difference in composition of blood as it enters and leaves an organ.



What is organ X?

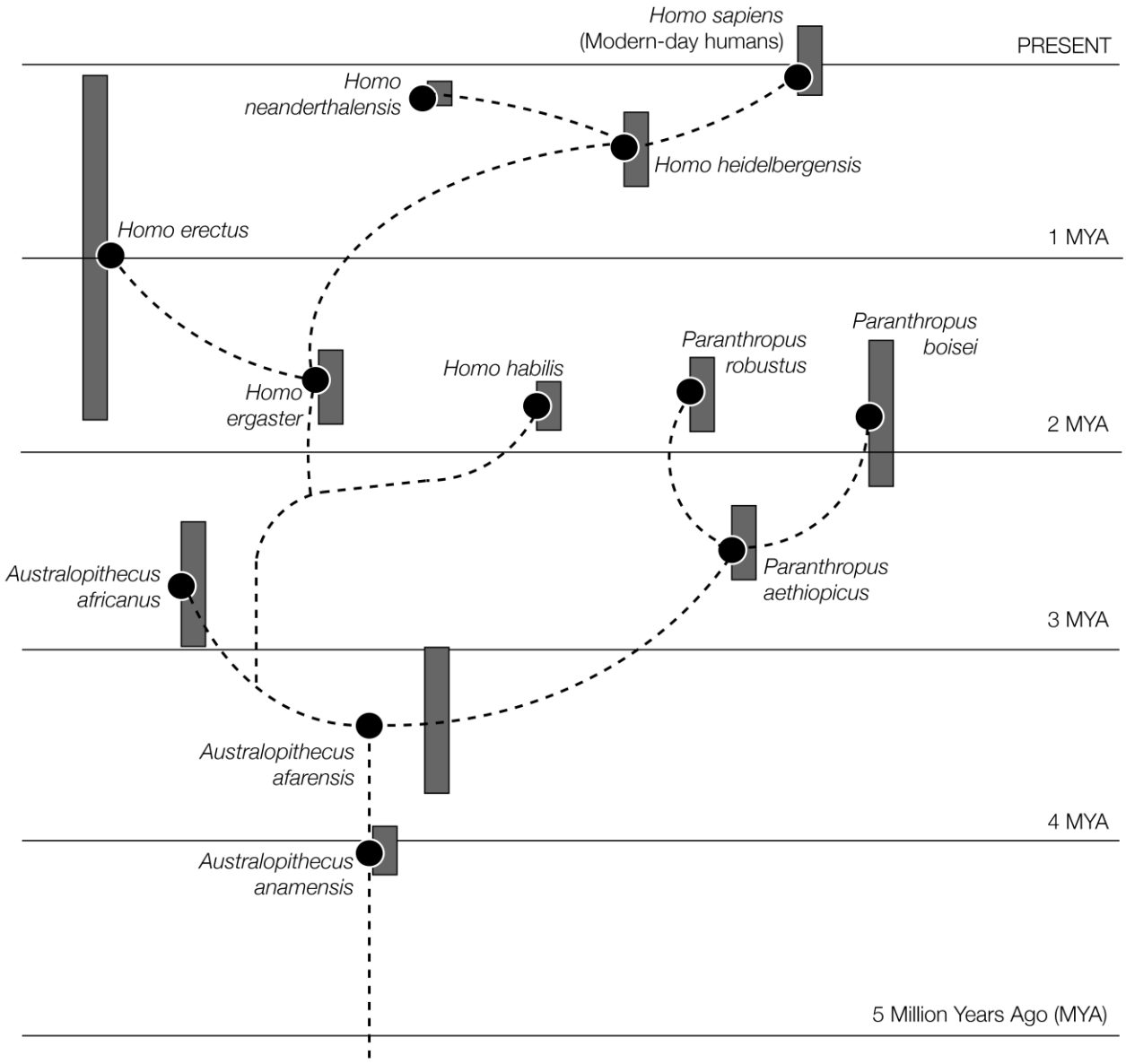
A. Brain

B. Heart

C. Kidneys

D. Lungs

19. The diagram below illustrates one interpretation of the origin of humans. The dotted lines indicate possible evolutionary relationships, and the vertical bars show the period from which fossils are known for each species.



Which of the following suggestions is reflected in the data above?

A. *Homo habilis* is an ancestor of modern humans.

B. *Homo sapiens* is descended from *Paranthropus aethiopicus*.

C. *Homo erectus* became extinct before modern humans appeared.

D. *Australopithecus* species may have given rise to modern humans.

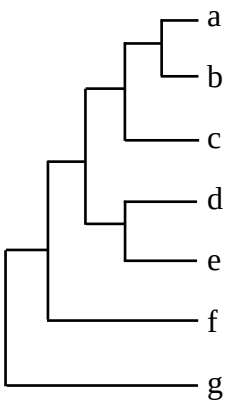
20. The following table shows the number of estimated mutations that have occurred in a gene among seven species.

The number of estimated nucleotide substitution mutations between each pair of species

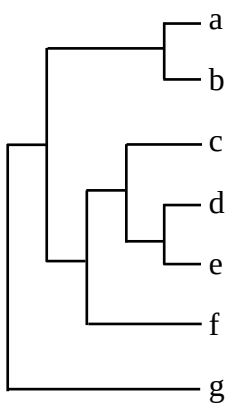
	b	c	d	e	f	g
a	39	72	128	126	159	269
b		81	130	128	158	268
c			129	127	157	267
d				56	154	271
e					151	268
f						273

Which is the most appropriate tree that shows the phylogenetic relationship among these seven species?

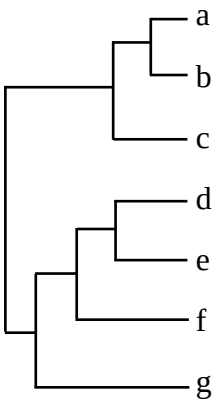
A.



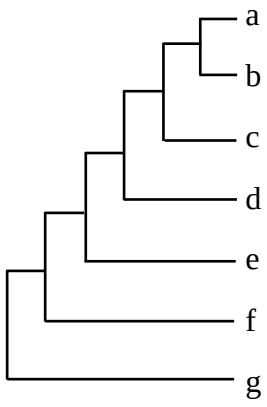
B.



C.



D.



End of Section I

Student Number

YEAR 11 YEARLY EXAMINATION

Biology
Section I – Objective Response

20 marks
Attempt Questions 1–20
Allow about 30 minutes for this section

Write your student number at the top of this Section I Response Booklet

Select the alternative A, B, C or D that best answers the question and fill in the response circle completely. Use ink for your answers.

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

2023 YEAR 11 YEARLY EXAMINATION

Examiner's Use Only		

Student Number								
Section I / 20								
Section II / 55								
Total / 75								

Biology
Section II

55 marks
Attempt Questions 21–27
Allow about 90 minutes for this section

Instructions

- Write your student number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of the response.
- Extra writing paper is available on the last page.
- If you need more paper than provided, please raise your hand to request more paper.
- If you use extra paper, clearly indicate your student number and which question you are answering.

Please turn over

Question 21 (7 marks)

The micrograph shows a cross section of a plant organ.

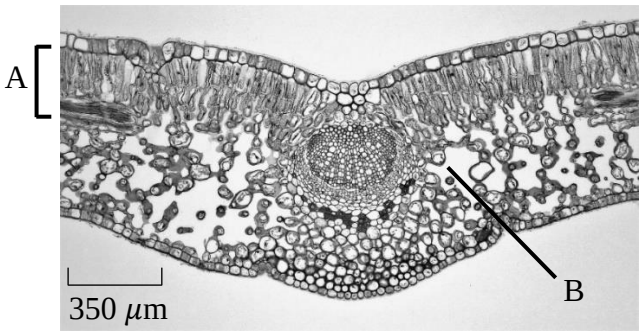


Figure 1

a) Identify the structures labelled as A and B. **2**

A = **palisade mesophyll (1mark)** B = **air space (1 mark)**

The image below shows a micrograph image of a plant organelle.

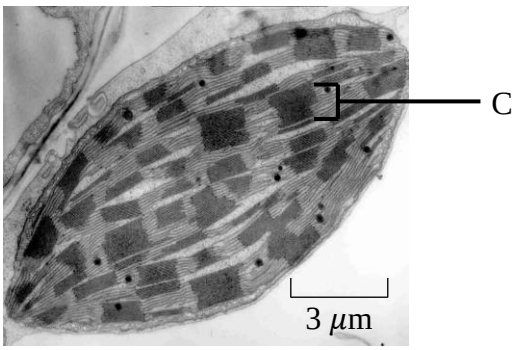


Figure 2

b) Identify the structure labelled as C. **1**

C = **granum (1mark)**

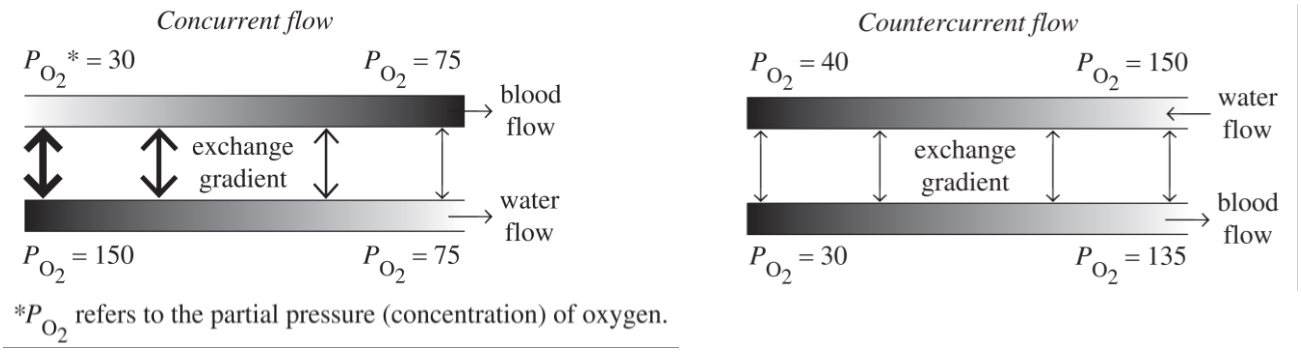
c) Draw a table to identify and distinguish between the technologies used to obtain the micrograph images shown in Figures 1 and 2. **4**

Features	Figure 1	Figure 2
Type	**Light microscope**	**Electron microscope**
Magnification	**100 000 X**	**1000 X**
Image production	**Uses the refraction and reflection of light**	**Uses the transmission of electrons**
Stain Used	**Chemical stains**	**Lead**

Criteria	Mark
▪ Table drawn correctly: used a ruler, closed off **– T** ▪ Table has 3 columns: features, light microscope, electron microscopes identified **– I** ▪ The information provided for light microscope is correct **– L** ▪ The information provided for electron microscope is correct **– E**	**4**

Question 22 (5 marks)

Countercurrent exchange mechanisms are used for a variety of reasons in living organisms. The diagram shows the concurrent and countercurrent flows in the gills of a fish.



*P_{O_2} refers to the partial pressure (concentration) of oxygen.

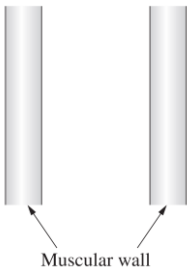
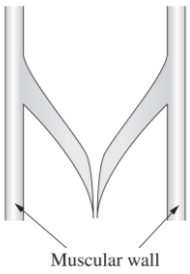
a) Explain why a fish benefits from a countercurrent flow across a lamella in its gills compared to concurrent flow. **2**

When water flows in the opposite direction (countercurrently) to the flow of blood in the lamellae, the **concentration gradient of O_2 is always present** and lower in blood compared to water **(C)**. This allows **O_2 to continually cross the membrane and enter the blood** from the water **(E)**.

Criteria	Mark
▪ Explains the answer fully providing the cause & effect **– C & E**	**2**
▪ Answer outlines the reason briefly **– O**	**1**

Fish have the simplest (closed) circulatory systems of all vertebrates. Two types of blood vessels that can be found in fish are shown below.

b) Complete the table with reference to the two types of blood vessels. **3**

Diagram of vessel		
Name of the vessel	Artery	Vein
Explain how ONE structural feature of the vessel enables it to carry out its function	Blood transported in the artery is pumped under high pressure, thick muscular walls in arteries allow for blood to be transported under high pressure without bursting.	Valves in veins allow for blood to be transported in one direction and prevent back flow as blood is not pumped back to the heart.

Criteria	Mark
▪ Identifies both the artery and vein correctly **– I** ▪ Explains how each structural feature allows the vessel to carry out its function **– A & V**	**3**
▪ Identifies both the artery and vein correctly **– I** ▪ Outlines how each structural feature allows the vessel to carry out its function**– O_1 &O_2**	**2**

Question 23 (5 marks)

In 2012, a fennec fox, not native to Australia, named Zahra was born at Taronga Zoo. In 2019, Zahra was moved to Adelaide Zoo where she is a favourite with visitors. Fennec foxes are nocturnal and visitors to Adelaide Zoo can often find Zahra snoozing during the day in her cave under heat lamps or finding a cool spot under the rocks in summer. A picture of a fennec fox with her keeper is shown.

a) Predict the type of biome and climate conditions observed in the native habitat of fennec Foxes. **2**

Biome = **desert (1mark)** Climate conditions = **hot and dry (1mark)**

b) Describe two distinct types of adaptations that can be observed in fennec foxes to allow them to survive in their natural habitat. **3**

Adaptation 1 – structural: small body size allows the fennec foxes to have a high SA:V ratio. This means that heat from metabolic reactions can dissipation away more effectively.

Adaptation 2 – behavioural: the fennec fox is seeks a more comfortable environment to thermoregulate by snoozing under the heat lamp during cooler days and hides under a cool rock when it's hot.

Answers could include:

Adaptation X – structural: large ears increase the surface area for the blood capillaries available to also allow the fennec fox to dissipate heat away effectively.

Adaptation X – physiological: the fennec fox is nocturnal and is active at night. This means that it has the ability to see in the dark so that it can gather food and navigate through the lack of light.

Criteria	Mark
▪ Describes two **distinct** adaptations that allow the foxes to survive the conditions identified in (a) **– A1, A2 & D**	**3**
▪ Describes two adaptations that allow the foxes to survive the conditions identified in (a) **– A1 & A2**	**2**
▪ Describes one adaptation that allow the foxes to survive the conditions identified in (a) **– A1 or A2**	**1**

Question 24 (8 marks)

a) Describe the function of a stomate **2**

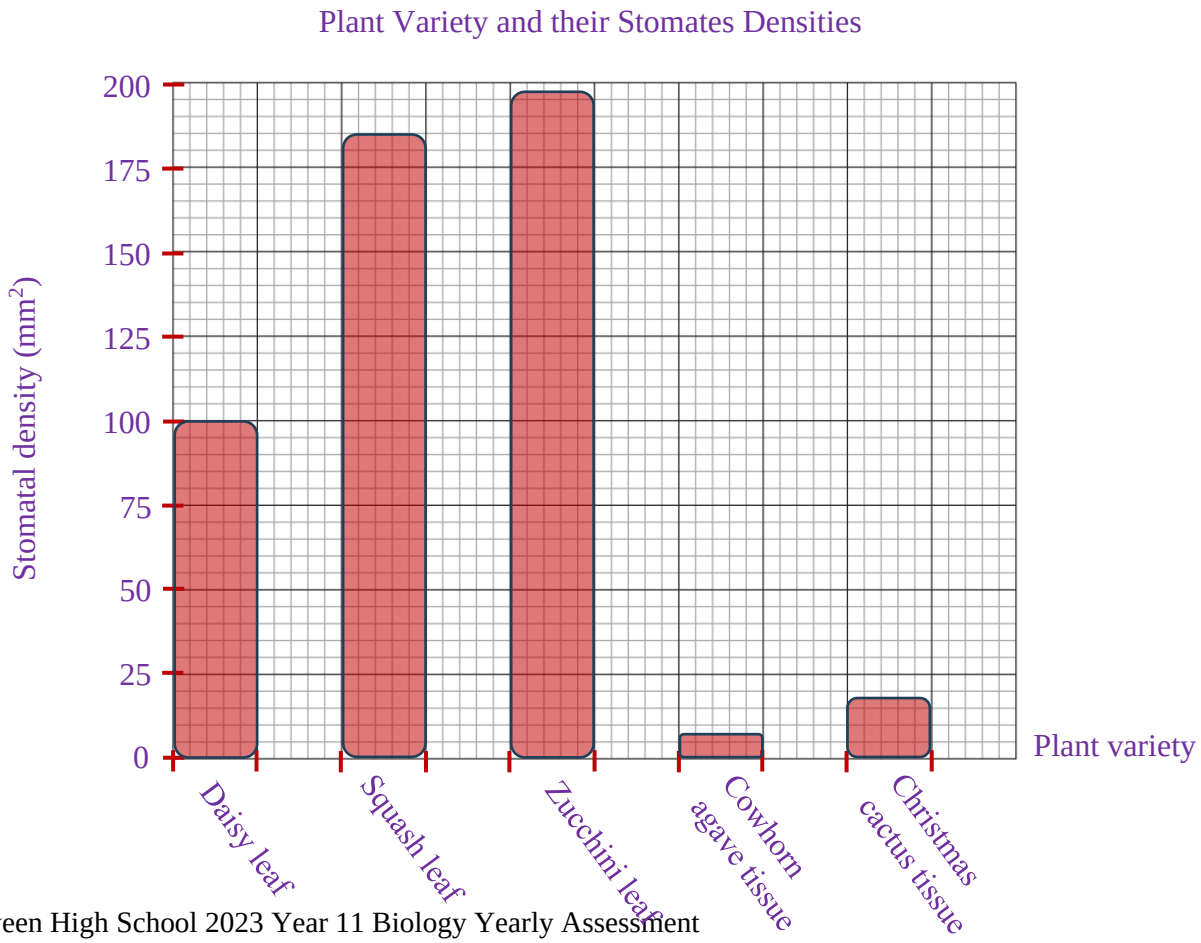
Stomates regulate gas exchange between the plant and environment. It is also responsible for the control of water loss by changing the size of the stomatal pore and allows the plants to thermoregulate through evaporative cooling.

Criteria	Mark
▪ Describes the functions of stomates as: 1) gas exchange & 2) evaporative cooling via transpiration **– F1 & F2**	**2**
▪ Describes the functions of stomates as: 1) gas exchange OR 2) evaporative cooling via transpiration **– F1 or F2**	**1**

Scientists compared the density of stomates of a variety of plants from different environments. The results are shown in the table.

Plant variety	*Stomatal density (mm^2)*
Daisy leaf (*Bellis perennis*)	100
Squash leaf (*Cucurbita argyrosperma*)	185
Zucchini leaf (*Cucurbita pepo*)	198
Cowhorn agave tissue (*Agave bovicornuta*)	8
Christmas cactus tissue (*Schlumbergera russelliana*)	17

b) Graph the data on the grid **3**



Criteria	Mark
The graph provided all of the following features: ▪ Title **– T** ▪ Label for x & y **– L** ▪ Values appropriate for x & y **– V** ▪ Column graph is used **– G** ▪ Correct plotting **– L**	**3**
▪ The graph provided 3 – 4 of the above features	**2**
▪ The graph provided 1 – 2 of the above features	**1**

Question 24 *continued*

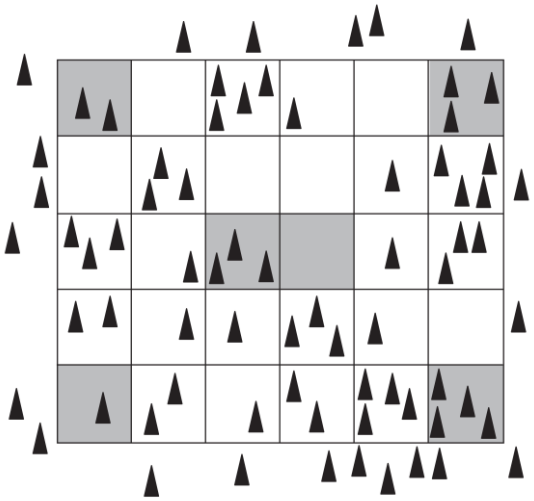
c) Determine which plants shown by the data are adapted do desert environment. Justify your answer. **3**

The Cowhorn agave tissue and Christmas cactus tissue are adapted to the desert environment. This is observable through the low stomatal density per mm^2 value as it allowed the plant to conserve more water by reducing water loss that can occur through the stomates.

Criteria	Mark
▪ Identifies both the Cowhorn agave tissue AND Christmas cactus tissue **– I** ▪ Justifies using the low stomatal density count **– S** ▪ Recognises the need to reduce water loss and for water conservation **– L**	**3**
▪ Answer achieves 2 of the above	**2**
▪ Answer achieves 1 of the above	**1**

Question 25 (3 marks)

The diagram represents a population of pine trees in a forest. Each quadrat is 10 m^2. Randomly selected quadrats have been shaded.



a) Use the shaded quadrats to estimate the total population of pine trees in the marked area of the forest. Show your working. **2**

$\frac{(2+3+3+0+1+4)}{60\ m^2} = 0.216$ $0.216 \times 300\ m^2 =$ **65 pine trees**

Criteria	Mark
▪ Answer uses the correct process to estimate the total population of pine trees	**2**
▪ Answer provides a relevant and correct step of the calculation	**1**

b) Outline one way to improve your estimate in part (a). **1**

Repeat the estimation using six different randomly selected quadrats and take the average of both estimates to ensure no counting errors have been made.

Question 26 (4 marks)

The diagrams below represent part of the human breathing system.

Diagram A

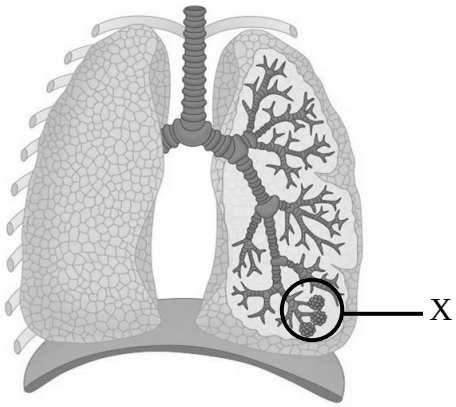
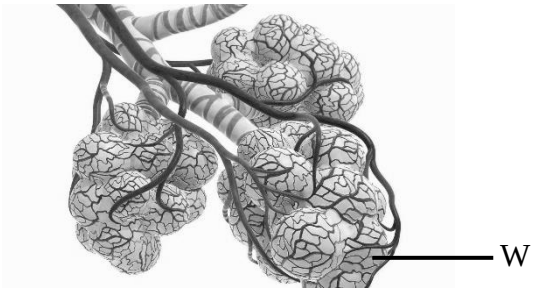


Diagram B
(This is a magnified view of X)

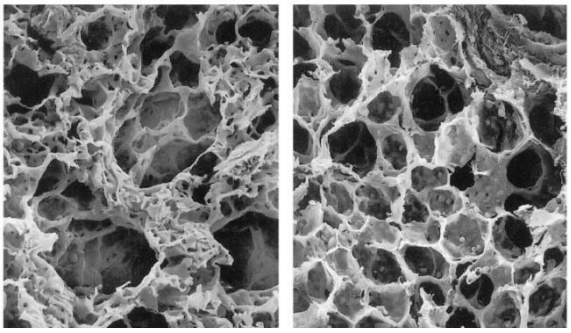


a) Describe two features of the Structure W which improve the efficiency of gas exchange. **2**

1. The alveoli hollow cup-shaped cavity allows for high surface area to ensure efficient gas exchange between the blood and the lungs.
2. The alveoli are also highly vascularised by the pulmonary capillary bed to ensure efficient gas exchange occurs between the blood and the lungs.
3. The alveoli are moist to allow for efficient adherence and diffusion of gases through the exchange surface.

Criteria	Mark
▪ Answer ***describes*** two of correct features of the alveoli/capillary network to allow for efficient gas exchange.	**2**
▪ Answer ***outlines*** two of correct features of the alveoli to allow for efficient gas exchange. Or ▪ Answer ***describes*** one of correct features of the alveoli to allow for efficient gas exchange.	**1**

Research suggests that exposure to second-hand smoke may cause an elevated risk of developing chronic obstructive pulmonary disease (COPD) resulting in reduced lung function that is irreversible. The electron micrographs below show the alveoli of a person consistently exposed to second-hand smoke for six months and a non-exposed person.



Cigarette smoke exposed Non-smoke exposed

[source: adapted from researchgate.net]

b) Explain how chronic exposure to second-hand smoke reduces lung function. **2**

Chronic exposure to second-hand smoke causes the degradation of the alveoli tissue, causing a loss of surface area and causes the air sac cavities to enlarge. As a result, less surface area or physical space of the alveoli, as well as the capillary, will be available for gas exchange. Furthermore, the larger air sacs would reduce air pressure inside the lungs causing a decrease in the available O_2 to cross the respiratory surface, hence reducing the rate of diffusion into the capillary bed.

Criteria	Mark
▪ Answer comprehensively explains how lung function is reduced (through larger air sacs AND reduced surface area)	**2**
▪ Answer briefly explains how lung function is reduced (through larger air sacs OR reduced surface area)	**1**

Question 27 (9 marks)

A food chain for organisms in a river and the biomass of the organisms at each trophic level is shown.

Algae	→	Invertebrate animals	→	Small fish	→	Large fish
Biomass in g/m^2:	840		200	40		10

a) Calculate the percentage of the biomass lost between the algae and the large fish. **2**

$\frac{(840 - 10)}{840} \times 100 =$ **98.81%**

Criteria	Mark
▪ Provides the correct calculation with working out	**2**
▪ Provides a correct step in the calculation	**1**

b) Outline two ways that biomass is lost between trophic levels. **2**

1. Biomass is lost between trophic levels through the inedible and/or undigested parts such as animal bones and cellulose in plants.
2. Some of the biomass is lost as faecal waste egested by the consumer as not everything that is consumed is absorbed by the organism.
3. Some of the biomass is lost via respiration removing organic matter from the organism in the form of CO_2.

Criteria	Mark
▪ Provides two outlines of how biomass is lost	**2**
▪ Provides one outline of how biomass is lost Or ▪ identifies two ways of how biomass is lost	**1**

It is observed that a large amount of untreated sewage entered the river. Many small fish died. Untreated sewage contains organic matter and bacteria.

c) Provide two reasons to explain why many small fish died. **2**

1. Bacteria also respire aerobically, depleting the oxygen concentration available to fish. Causing them to die.
2. Bacteria produce chemical substances that could be toxic to fish. The build-up of these chemicals can harm the fish and causing them to die.
3. Bacteria are pathogenic and some could be disease-causing?

Criteria	Mark
▪ Provides two reasons to explain why small fish died	**2**
▪ Provides one reason to explain why small fish died Or ▪ Outlines two reasons why small fish died	**1**

Note: those who said the bacteria causes the invertebrates which are the food sources of fish to die, removing their food source, was not given a mark because this would mean that the entire ecosystem would appear to have collapsed and not just the population of small fish.

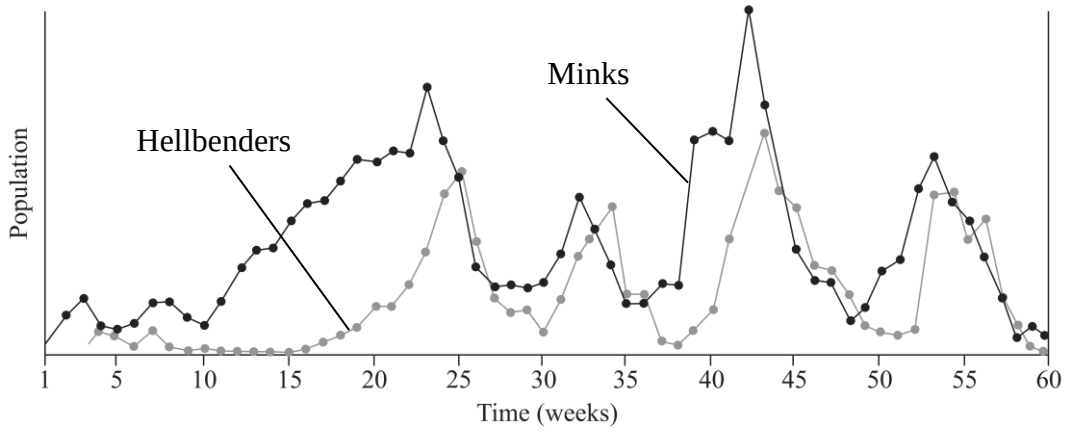
d) Predict what will happen to the ecosystem of this river as a result of the untreated sewage river dumping. Assuming the large fish do not consume the invertebrate animals as a food source. **3**

The river's ecosystem will collapse. This is because a reduction in the small fish population will cause the large fish's population to reduce. The invertebrate animal's population will increase and demand more algae as a food source. This will deplete the producers of this ecosystem and energy can no longer flow into this ecosystem to maintain it.

Criteria	Mark
▪ Comprehensively recognises that the ecosystem will collapse by predicting what will happen to all the other ***three*** trophic levels **– T1, T2, T3**	**3**
▪ Predicts what will happen to ***two*** of the other trophic levels	**2**
▪ Predicts what will happen to ***one*** of the other trophic levels	**1**

Question 28 (5 marks)

Hellbenders and minks can both be found in regions of North Eastern America. Their activities are observed in the rivers and streams where they are found to share similar ecological niche. The graph below shows the changes in the numbers of hellbenders and minks across a 60-weeks period.



a) Identify the type of relationship in the interactions between the hellbenders and the minks. **1**

Predator-prey relationships **(1mark)**

b) Using the data shown in the graph, describe and explain the changes in the populations of the hellbenders and minks. **3**

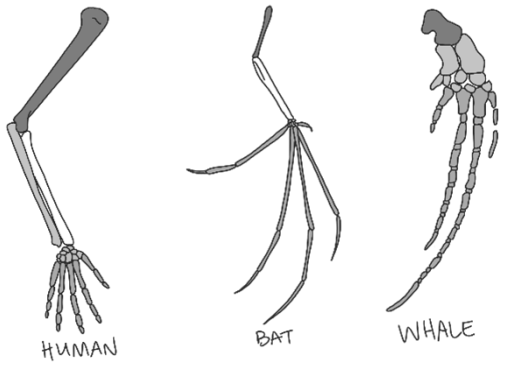
Hellbenders and minks have a predator-prey relationship. This means that one eats the other. According to the graph, the population of hellbenders population is either at the same level or lower than minks at any point in time. The hell benders are they predators and minks are the prey. The population of the prey needs to be higher than the predator's population to sustain the predator's food source. As the population of the hellbenders/predators increase, the population of the minks/prey will decrease sometime after as more of the prey are consumed by the predator. As the population of the prey decrease, the food source will be restricted, as a result, the predator's population will decrease.

Note: the minks are really the predators and hellbenders are preys. But question was marked as per the incorrect labels.

Criteria	Mark
Answer achieves 5-6 of the following: ▪ the predator's population must always be lower than prey **– P** ▪ when the population of the prey increases, population of the predator increases **– T1** ▪ when the predator's population increases, the population of the prey decreases **– T2** ▪ when the population of the prey decreases, the population of the predator decreases **– T3** ▪ answer provides a reason for the above observation **– R** ▪ answer uses the data shown in the graph **– D**	**3**
▪ Answer achieves 3-4 of the above	**2**
▪ Answer achieves 1-2 of the above	**1**

Question 29 (4 marks)

Source 1 shows four vertebrate forelimbs and Source 2 shows the wing structure of three flying organisms.



Source 1

Source 2

Butterfly Bats birds

a) Demonstrate how Sources 1 and 2 can be used as evidence to support the theory of evolution. **4**

Evidence 1 shows the pentadactyl limb of human, bat and whale. They are homologous structures that are used to demonstrate divergent evolution. Homologous structures are traits that share a common ancestry, who gave these organisms the pentadactyl limb structure, but appears to have adapted to different functions over time due to divergence of species as a result of natural selection.

The wings of birds, bats and butterflies are analogous structures which provide evidence to support convergent evolution. Convergent evolution occurs when distantly related species independently evolve similar traits or features in response to similar environmental pressures and this trait is absent in the organisms' recent common ancestor.

Criteria	Mark
Answer achieves 7-8 of the following to recognise that ▪ The bone structures, pentadactyl limb, of humans, bats and whales are homologous structures **– H** ▪ Homologous structures are traits that share a common ancestry but have different functions **– F** ▪ Differences in the homologous structures occur due to differences in selection pressures **– S1** ▪ Homologous structures provide evidence for divergent evolution **– E1** AND ▪ The wing structures of butterflies, birds and bats are analogous structures **– A** ▪ Analogous structures are traits that looks similar or are of similar functions but are not inherited from the most recent common ancestor **– C** ▪ Similarities of the analogous structures are due to similar selection pressures **– S2** ▪ Analogous structures provide evidence for convergent evolution **– E2**	**4**
▪ Answer achieves 5-6 of the above	**3**
▪ Answer achieves 3-4 of the above	**2**
▪ Answer achieves 1-2 of the above	**1**

Exam continues on the next page.

Question 30 (6 marks)

The following media release was published on the James Cook University website in May 2023 to highlight a study being carried out by the university that observe urbanisation as an evolutionary force.

> Distinguished Professor Lin Schwarzkopf, Head of Zoology and Ecology at James Cook University, was part of a team that examined how cane toads are changing in cities.
>
> "Urban areas have been expanding rapidly, and this rapid expansion has caused drastic environmental changes over recent decades. Natural habitats, such as parks and gardens, are often isolated from each other by artificial barriers like buildings and roads and this isolation can make evolution quicker." Said Professor Schwarzkopf.
>
> Professor Schwarzkopf said one instance of this was seen in toads.
>
> The team collected more than 400 cane toads from three different sites in north Queensland and measured them.
>
> "We found that the parotoid glands, which are the major anti-predator defence of toads, were smaller in urban than in rural populations. The tibiofibular (a bone in the leg) length of males in urban populations was longer than those in rural populations, but females showed opposite trends," said Professor Schwarzkopf.
>
> "When toads roam around urban areas, they may have to move further in a single trip to overcome barriers such as roads and buildings. Given that male toads tend to move more often than females, males with longer tibiofibular, and therefore better movement ability, may be favoured in urban environments. However, less sedentary females may not experience a similar benefit," …
>
> In any case, the results demonstrate that urbanisation drives the size, shape, and structure of invasive toads, suggesting they may rapidly be adapting to urban environments.

Using your knowledge of Darwin and Wallace's Theory of Evolution by means of Natural Selection, analyse the evolution of the cane toads observed by Professor Schwarzkopf's team. **6**

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More writing space is available on the next page.

Question 20 *continued*

Criteria	Mark
Answer achieves 11-12 of the following: ▪ Recognises the evolution of the cane toads in urban areas to have: **(T1)** smaller parotoid glands, **(T2)** longer leg bones in males, **(T3)** shorter leg bones in females ▪ Demonstrates an understanding of Darwin's theory of evolution via natural selection: **(V)** variation, **(N)** natural selection, **(A)** adaptation, **(H)** heredity ▪ Understands that urbanisation force populations of toads to be isolated **(I)** from each other causing an acceleration in the evolution of toads **(R)** ▪ Explains that toads evolved to have smaller parotoid glands due to the lack of need for the cane toads to use it as a defence mechanism compared to those in the wild **(P)** ▪ Explains that male toads evolved to have longer legs to traverse a larger area in search of food allowing them to survive & pass this traits on to offspring **(M)** ▪ Explains that female toads evolved to have shorter legs because these frogs can't move as fast, allowing for male frogs to catch them and breed more often, passing on these traits **(F)**	**6**
▪ Answer achieves 9-10 of the above	**5**
▪ Answer achieves 7-8 of the above	**4**
▪ Answer achieves 5-6 of the above	**3**
▪ Answer achieves 3-4 of the above	**2**
▪ Answer achieves 1-2 of the above	**1**

Note: marking criteria was modified to change the L criteria to P. Should affect only a small number of students.

End of Section II

Extra paper

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1. The alveoli hollow cup-shaped cavity allows for high surface area to ensure efficient gas exchange between the blood and the lungs.
2. The alveoli are also highly vascularised by the pulmonary capillary bed to ensure efficient gas exchange occurs between the blood and the lungs.
3. The alveoli are moist to allow for efficient adherence and diffusion of gases through the exchange surface.