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Girraween High School

2020 YEAR 11 YEARLY 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 – 15 marks

- Attempt questions 1–15
- Allow about 20 minutes for this part

Section II – 60 marks

- Attempt questions 16–27
- Allow about 1 hour and 40 minutes for this part

Section I

15 marks

Attempt Questions 1–15

Allow about 20 minutes for this part

Use the multiple-choice answer sheet for Question 1–15.

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

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

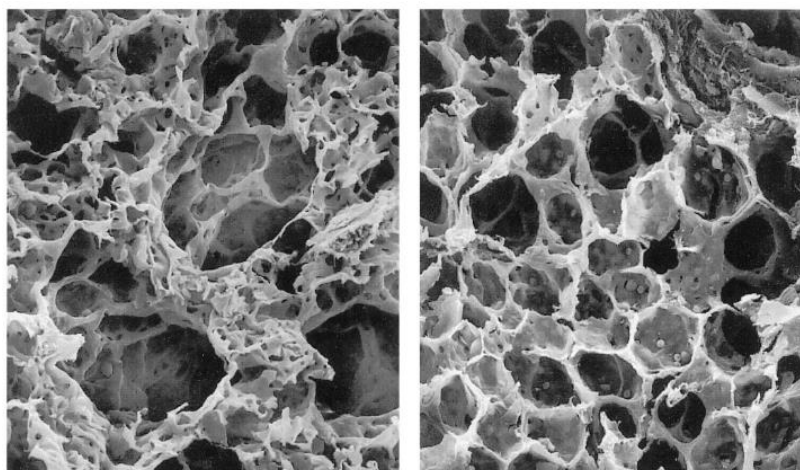
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correct
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-
1. In ecology, how is community defined?
- A. Different families cooperating with each other.
 - B. A specific area in which a group of species normally live.
 - C. Different species living and interacting with each other in a specific area.
 - D. A group of organisms of the same species who live in a specific area at the same time.
2. What is the energy absorbed by chlorophyll used directly for in plants?
- I. To produce ATP
 - II. To split water
 - III. To fix CO₂
- A. I only
 - B. I and II only
 - C. II and III only
 - D. III only

3. Research suggests that exposure to second-hand smoke may cause an elevated risk of developing chronic obstructive pulmonary disease (COPD). COPD results in reduced lung function that is largely 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.

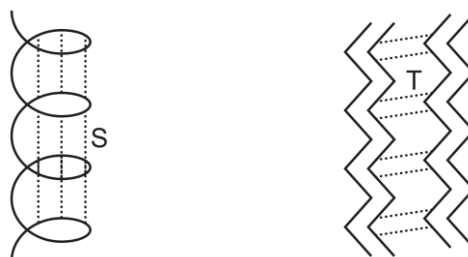


Cigarette smoke exposed

Non-smoke Exposed

What can be observed in the alveoli of a person exposed to cigarette smoke?

- A. Small surface area, large air spaces and few capillaries
 - B. Small surface area, small air spaces and few capillaries
 - C. Large surface area, large air spaces and many capillaries
 - D. Large surface area, small air spaces and many capillaries
4. The diagrams show two possible arrangements of amino acids in a protein.

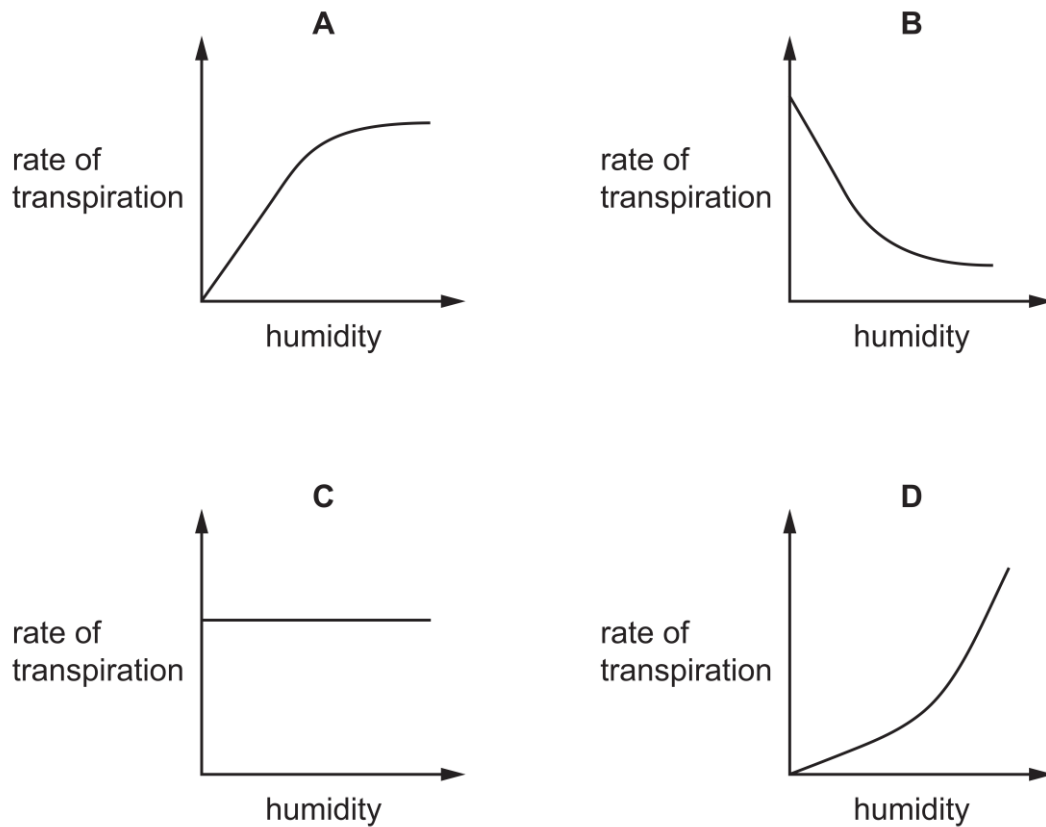


Which option below correctly identifies the type of bonding present in S and T?

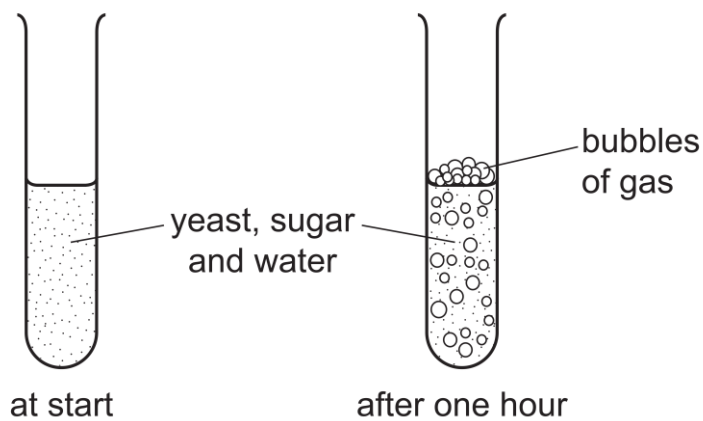
	ionic bond	hydrogen bond
A.	Absent	S and T
B.	S only	T only
C.	S and T	absent
D.	T only	S and T

5. Which vessel carries deoxygenated blood from the heart to the lungs?
- A. Vena cava
 - B. Coronary vein
 - C. Pulmonary vein
 - D. Pulmonary artery
6. During expiration, how does air pressure in the lungs compare with atmospheric pressure?
- A. Lung air pressure is less than atmospheric pressure.
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7. Which features of companion cells are essential to their function?
- 1 They are connected by plasmodesmata to the sieve tube elements
 - 2 They have a thinner cell wall than a sieve tube element
 - 3 They contain a nucleus and mitochondria
- A. 1, 2 and 3
 - B. 1 and 2 only
 - C. 1 and 3 only
 - D. 2 and 3 only
8. How is energy transferred in a food chain?
- A. Combustion
 - B. Ingestion.
 - C. Photosynthesis.
 - D. Respiration.

9. Which graph shows most clearly what will happen to the rate of transpiration as humidity increases?



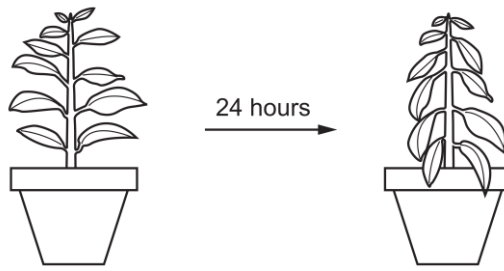
10. Some yeast, sugar and water are mixed in a test-tube. The diagrams show the test-tube at the start and after one hour.



Which process causes this change?

- A. Cellular respiration
- B. Digestion
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- D. Photosynthesis

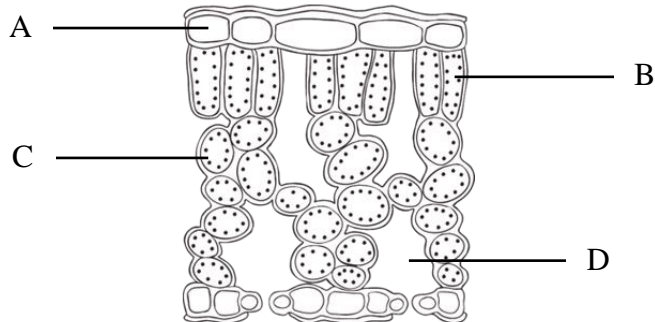
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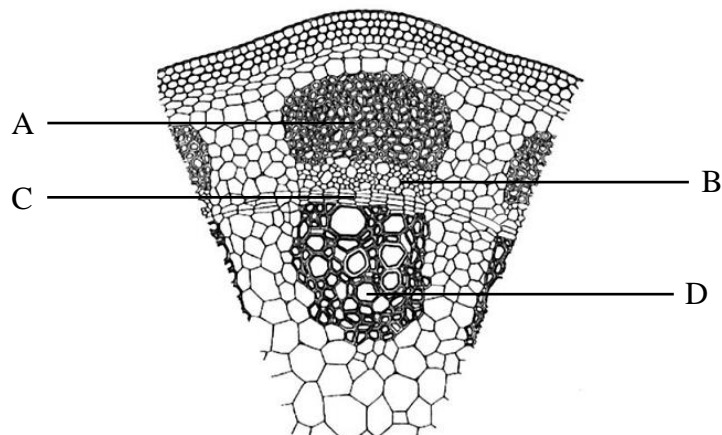
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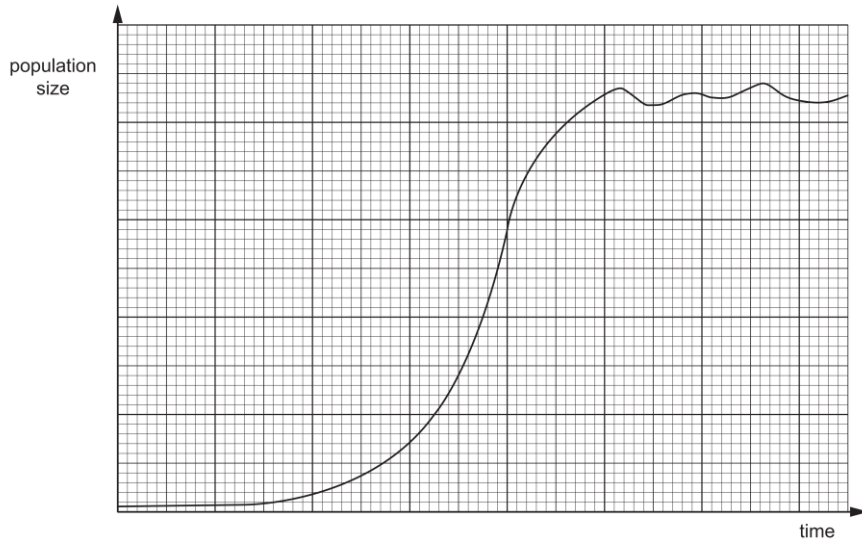
12. The photograph shows a section through the leaf of a plant. Which label shows the palisade mesophyll?



13. The diagram below shows a partial cross-section of the stem of a vascular plant. Which label shows the cells through which translocation occurs?

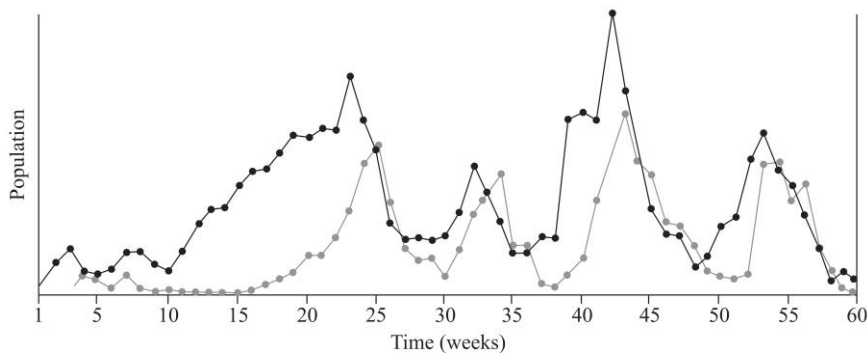


14. Cane toads were released into the Australian ecology in 1935 with the hope to control the destructive cane beetle population. The graph shows how their population size changed over the next few years.



What explains the way the size of the cane toad population changed during the exponential phase?

- A. Birth rate and death rate were in equilibrium.
 - B. Limiting factors begin to take effect.
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15. The graph below shows the change in population abundance for two interacting species in a community.



What is the relationship between the two species based on the change in population abundance?

- A. Amensalism
- B. Commensalism
- C. Mutualism
- D. Predator – prey

End of Section I

Student Number								
Total /15								

Biology
Section I – Objective Response

15 marks
Attempt Questions 1 – 15
Allow about 20 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.

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- 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

Student Number								
Section I /25								
Section II /60								
Total /75								

**Biology
Section II**

**60 marks
Attempt Questions 16 – 27
Allow about 1 hour 40 minutes for this section**

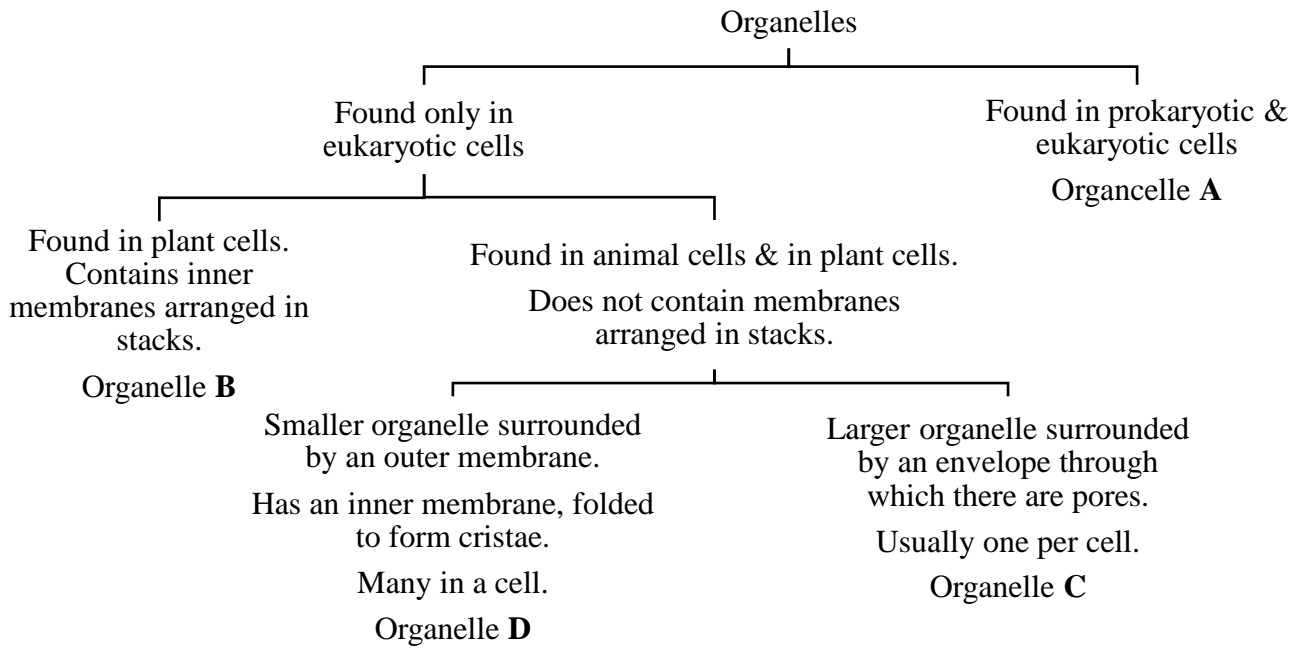
Instructions

- 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 16 (6 marks)

The flowchart below shows how some organelles may be distinguished from each other.



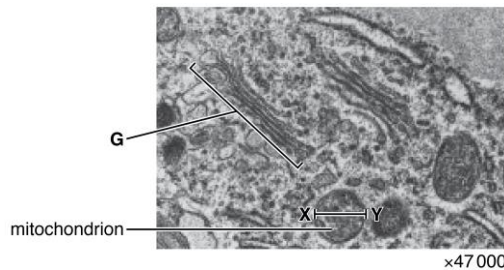
a) Identify organelles **A** and **B**. 2

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b) Relate the structure of organelle **B** to its function. 2

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The image below is an electron micrograph of part of a eukaryotic cell.

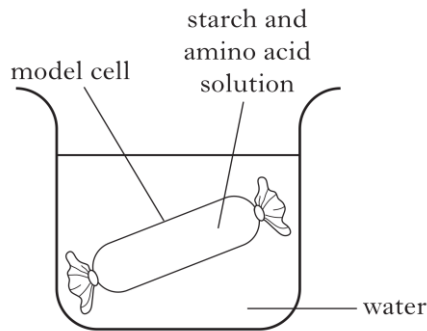


c) Identify organelle **G** and state how it is possible to deduce that the image above is a transmission electron micrograph and not a scanning micrograph. 2

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Question 17 (4 marks)

A model cell was made using a dialysis tubing bag filled with a starch and amino acid solution. It was placed into a beaker of water and left for two hours.



- a) Amino acids were detected in the water outside the model cell but not starch. Suggest a possible explanation for this observation. 2

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- b) Predict what would happen to the mass of the model cell during the two-hour period. Explain your answer using appropriate scientific terminology for any relevant phenomenon/process. 2

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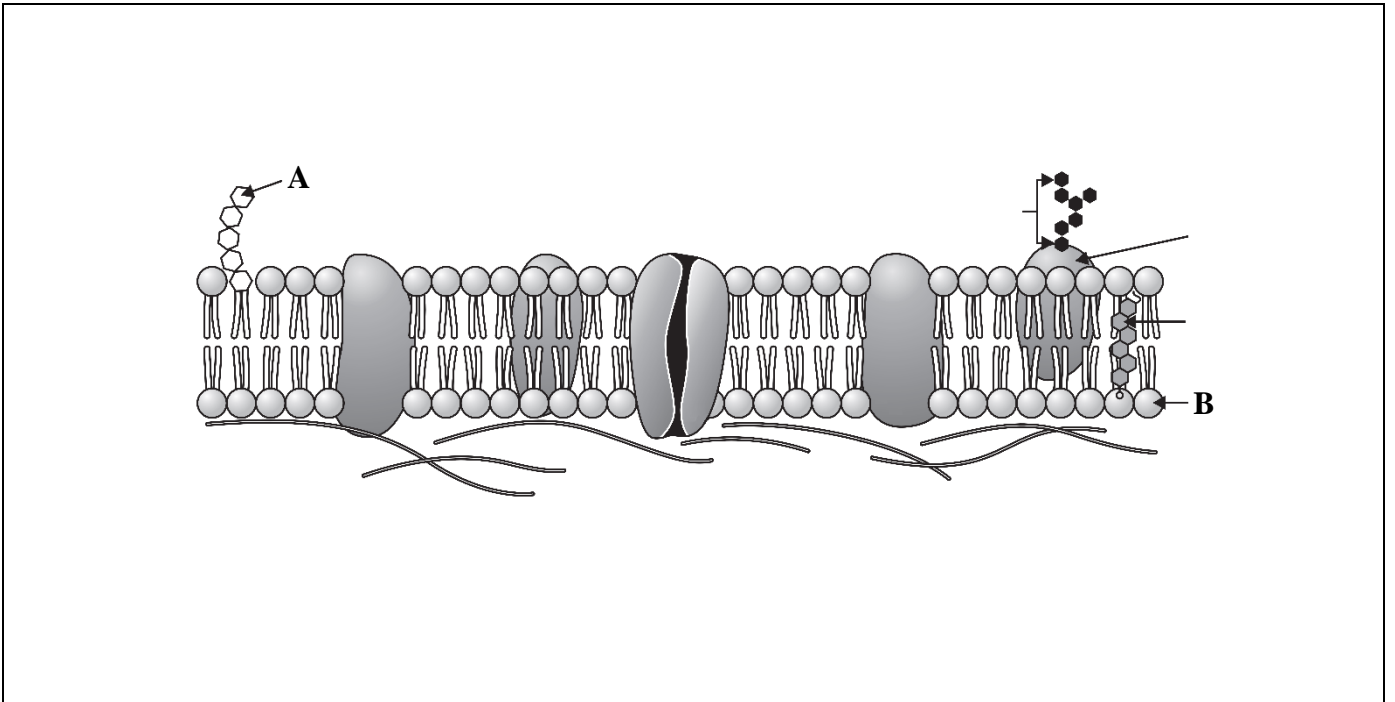
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Question 18 (6 marks)

Below is a section of the plasma membrane of an animal cell.



a) Identify components **A** and **B**.

2

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b) Annotate the diagram by the use of shapes, arrows and text to distinguish between active and passive transporting of substances across the membrane shown above.

2

c) Justify why biological systems utilise both passive and active forms of transport.

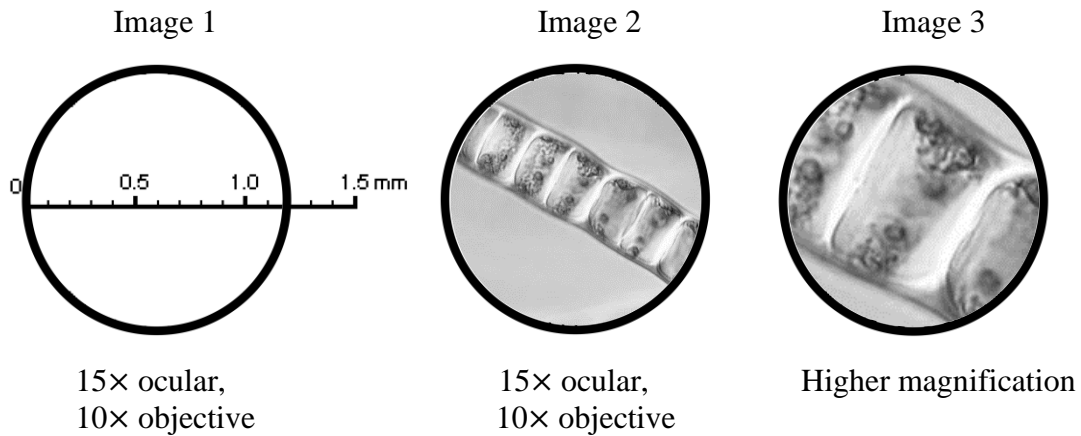
2

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Question 19 (4 marks)

Each image below is of a whole field of view as seen under a microscope. In Images 1 and 2 an ocular lens with a 15× magnification, and an objective lens with a 10× magnification were used. Image 3 was made using a higher magnification.

Drawing 1 shows a 1.5 mm scale in the field of view. Images 2 and 3 are of the same chain of cells in the alga *Ulothrix*.



- a) Estimate the length (in μm) of one cell of *Ulothrix* in Image 2. Show your working. **2**

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- b) Calculate the diameter of the field of view (in μm) and the magnification of Image 3. **2**

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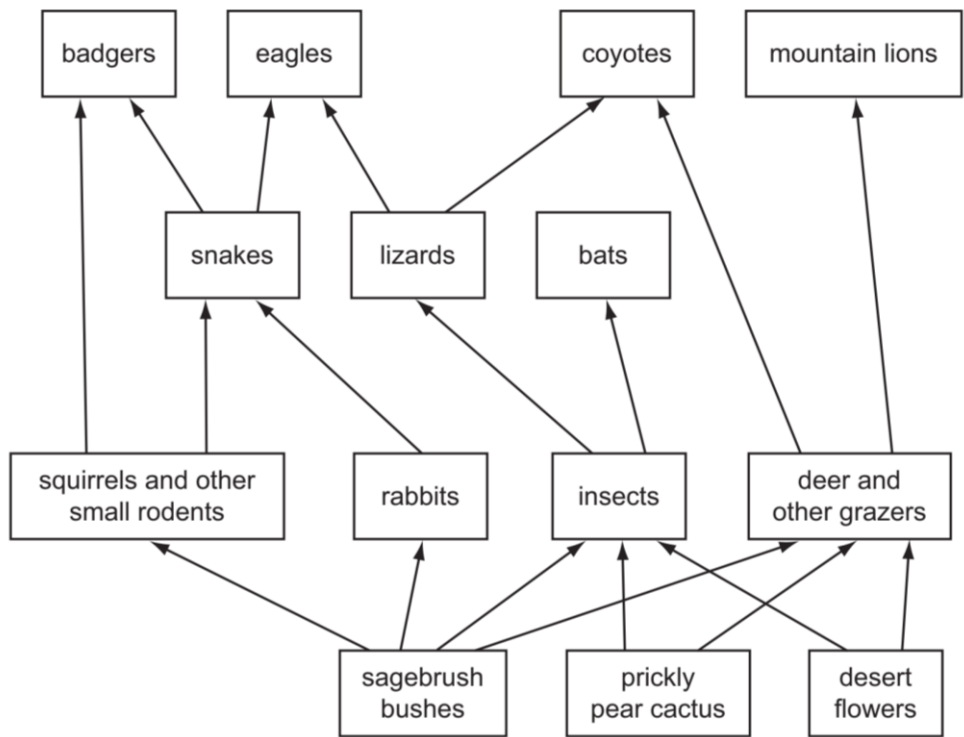
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Question 20 (6 marks)

The figure below shows the biotic interactions in a community.



a) Distinguish between a food web and a food chain.

2

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b) Name a consumer from the 2nd trophic level shown in the figure above.

1

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c) In some regions, deer and other grazers have been hunted and face extinction. Suggest how the extinction of deer and other grazers would affect other animals in this community.

3

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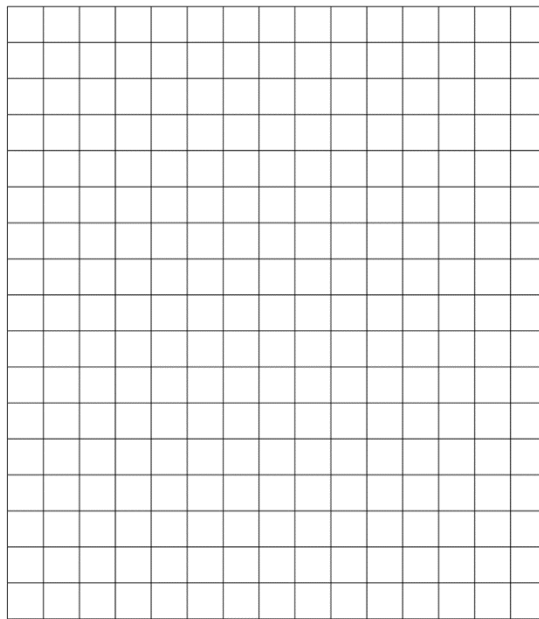
Question 21 (6 marks)

The table below shows the surface area and volume for four different-sized potato cubes

Potato Cubes		
Cube Size (cm)	Surface Area (cm ²)	Volume (cm ³)
2	24	8
3	54	24
4	96	64
5	150	125

- a) Graph the volume of each cube against its surface area using the same increment for the X & Y axes.

3



- b) Use the information shown in graph to justify the adaptation of the size of cells.

3

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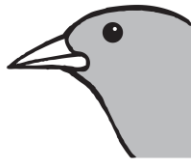
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Question 22 (7 marks)

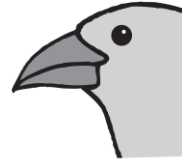
The diagrams below shows three species of finches which live on the Galapagos Islands as observed by Charles Darwin on his voyage.



Feeds on insects



Feeds on seeds



Feeds on seeds

a) Explain why these finch species occupy different niches.

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b) Explain, using examples, how Darwin and Wallace's Theory of Evolution by Natural Selection accounts for convergent evolution.

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c) Some areas on the islands have a thin layer of soil and low rainfall. Describe an adaptation that could be observed in plants native to these areas that will help them survive.

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Question 23 (2 marks)

Some oceans surrounding Australia lack nutrients compared with other oceans. Australian fur seal pups are suckled for longer and develop at a slower rate than seal pups in other parts of the world.

2

Suggest why this strategy is useful for survival.

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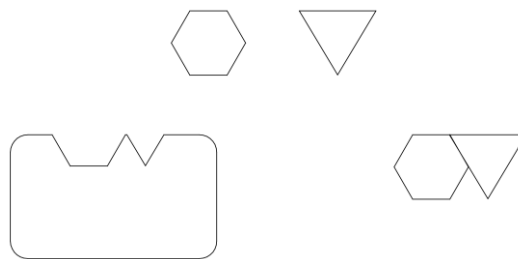
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Question 24 (3 marks)

The diagram below shows components of a model of how an enzyme works.



a) Label the components shown in the diagram.

1

b) Justify the importance of enzymes in biological systems.

2

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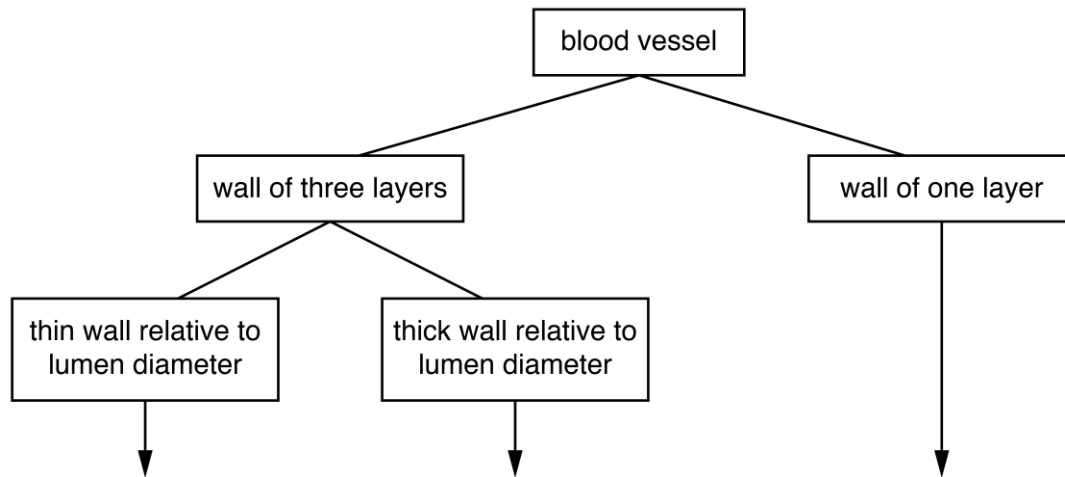
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Question 25 (7 marks)

The diagram below shows features that are observed in transverse sections of three types of blood vessel.



H **I** **J**

a) Complete the diagram above by identifying the type of blood vessel indicated by **H** and **J**. **2**

b) Explain how the structure of **I** is related to its function. **2**

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c) With the use of examples, compare an open circulatory system to a closed circulatory system. **3**

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Question 26 (4 marks)

The fossil below was discovered by South African palaeontologist Billy de Klerk near a small town in Grahamstown's region in 2005. The fossil is of a relatively small dinosaur species called *Heterodontosaurus tucki*, weighing between 2-10 kg, and is believed to be 200 million years old.



- a) Using the fossil record shown, predict the type of diet consumed by the *Heterodontosaurus tucki*. **1**

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- b) Comment on two features that might be observable in the alimentary canal of *Heterodontosaurus tucki*. Justify your answer. **3**

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Question 27 (5 marks)

The table below shows comparisons between the amino acid sequences in the DNA of the echidna, the grey kangaroo, the platypus and the potoroo.

Pairs of organisms	Number of amino acid differences
Platypus – Grey Kangaroo	35
Platypus – Echidna	10
Platypus – Potoroo	32
Echidna – Potoroo	29
Echidna – Grey Kangaroo	34
Potoroo – Grey Kangaroo	11

a) Draw a tree to show the evolutionary relationship between the organisms in the table.

2

b) Explain your reasoning with specific reference from the data.

3

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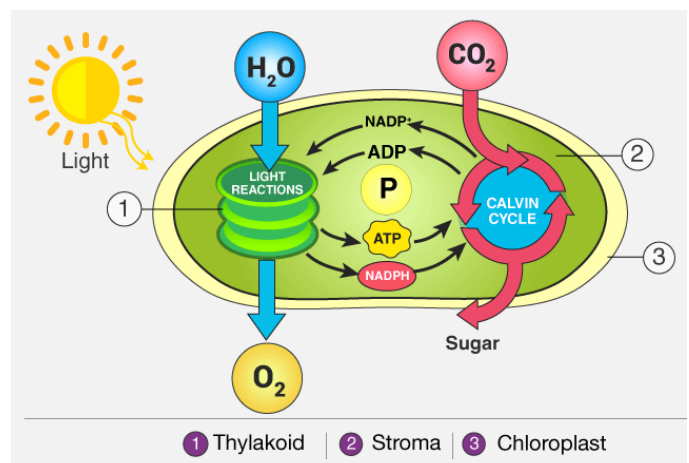
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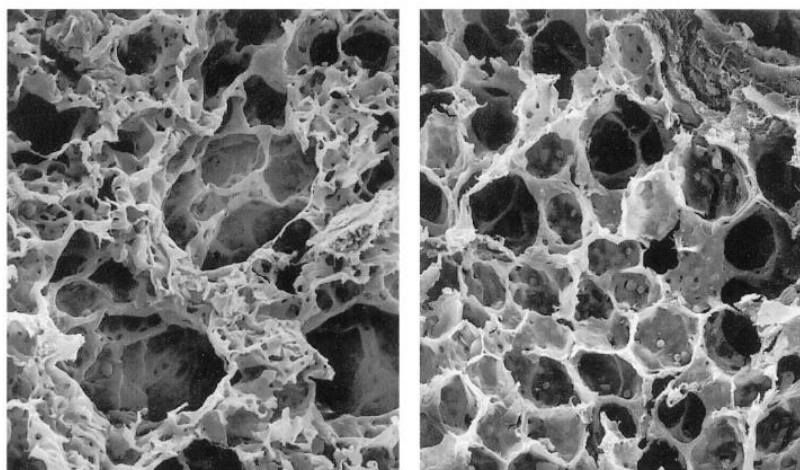
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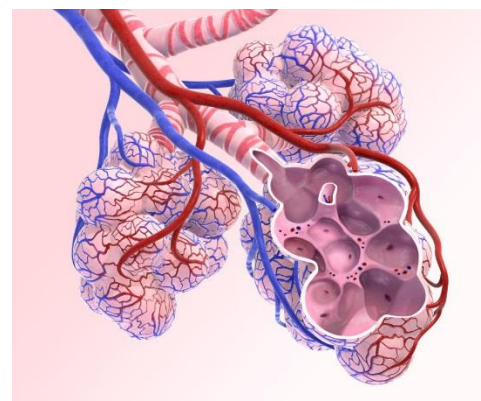
Non-smoke Exposed

[source: adapted from researchgate.net]

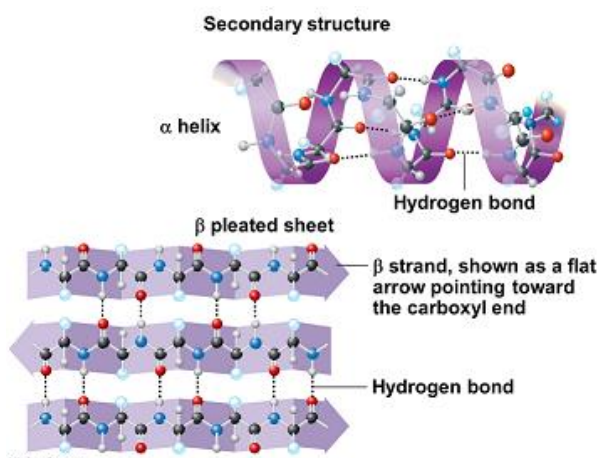
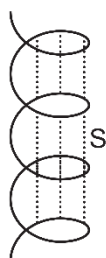
https://www.medicinenet.com/smokers_lung_pathology_photo_essay/article.htm

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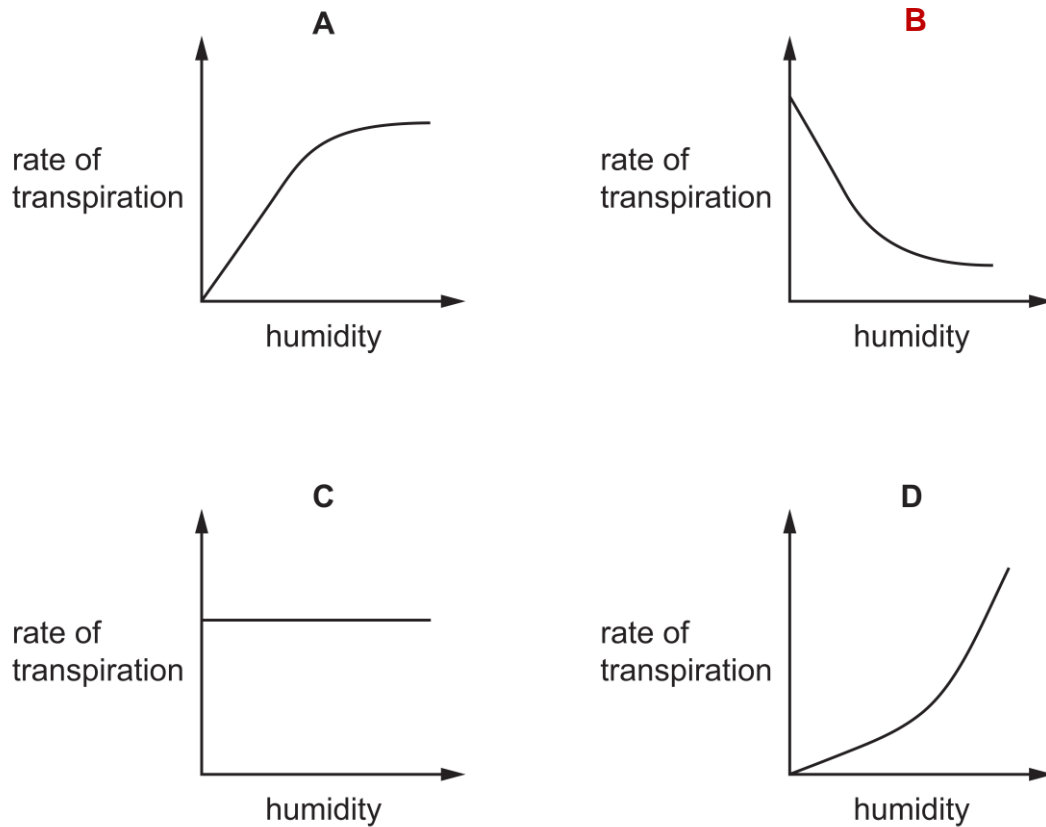
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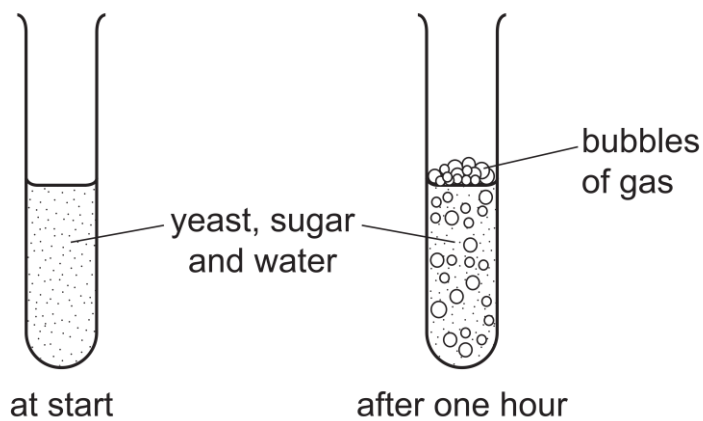
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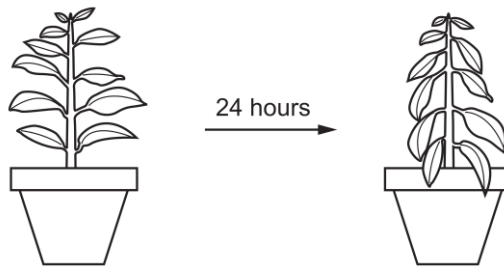
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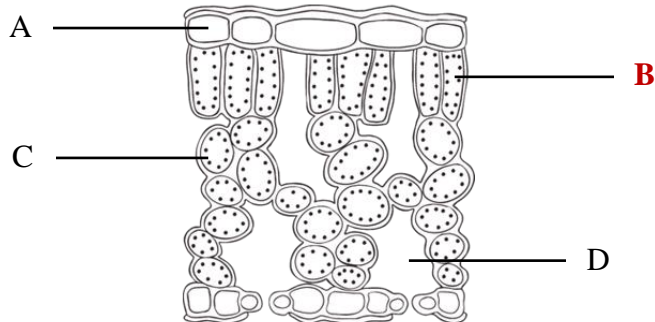
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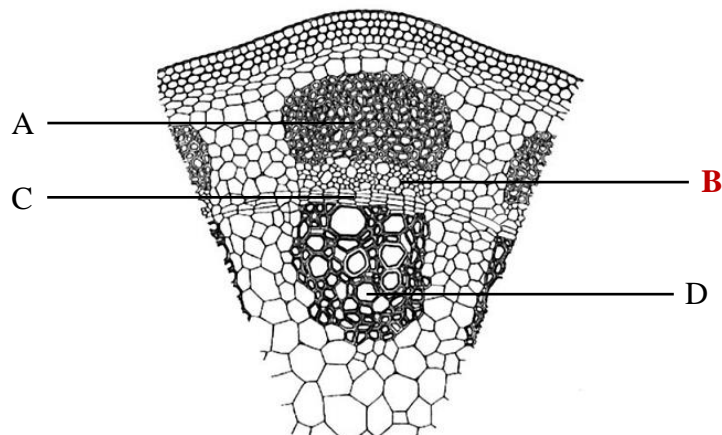
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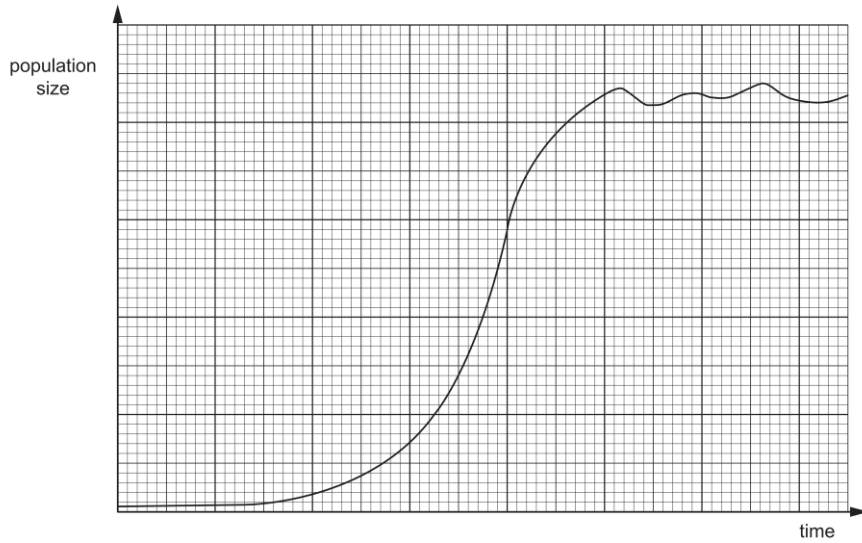
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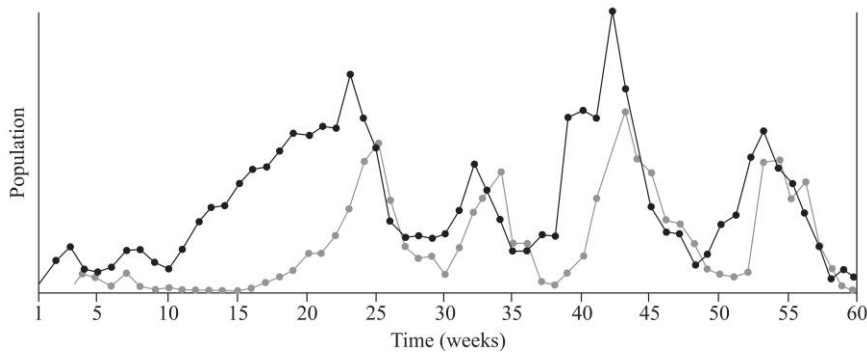


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- C. Mutualism
- D. Predator – prey**

End of Section I

2020 YEAR 11 YEARLY EXAMINATION

Examiner's Use Only		

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Biology
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Use ink for your answers.

- | | | | | |
|-----|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| 1. | A <input type="radio"/> | B <input type="radio"/> | C <input checked="" type="radio"/> | D <input type="radio"/> |
| 2. | A <input type="radio"/> | B <input checked="" type="radio"/> | C <input type="radio"/> | D <input type="radio"/> |
| 3. | A <input checked="" type="radio"/> | B <input type="radio"/> | C <input type="radio"/> | D <input type="radio"/> |
| 4. | A <input checked="" type="radio"/> | B <input type="radio"/> | C <input type="radio"/> | D <input type="radio"/> |
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| 6. | A <input type="radio"/> | B <input checked="" type="radio"/> | C <input type="radio"/> | D <input type="radio"/> |
| 7. | A <input type="radio"/> | B <input type="radio"/> | C <input checked="" type="radio"/> | D <input type="radio"/> |
| 8. | A <input type="radio"/> | B <input checked="" type="radio"/> | C <input type="radio"/> | D <input type="radio"/> |
| 9. | A <input type="radio"/> | B <input checked="" type="radio"/> | C <input type="radio"/> | D <input type="radio"/> |
| 10. | A <input checked="" 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 checked="" type="radio"/> | D <input type="radio"/> |
| 12. | A <input type="radio"/> | B <input checked="" type="radio"/> | C <input type="radio"/> | D <input type="radio"/> |
| 13. | A <input type="radio"/> | B <input checked="" 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 checked="" type="radio"/> |
| 15. | A <input type="radio"/> | B <input type="radio"/> | C <input type="radio"/> | D <input checked="" type="radio"/> |

2020 YEAR 11 YEARLY EXAMINATION

Examiner's Use Only		

Student Number								
Mark / 60								
Total								

**Biology
Section II**

**60 marks
Attempt Questions 16 – 27
Allow about 1 hour 40 minutes for this section**

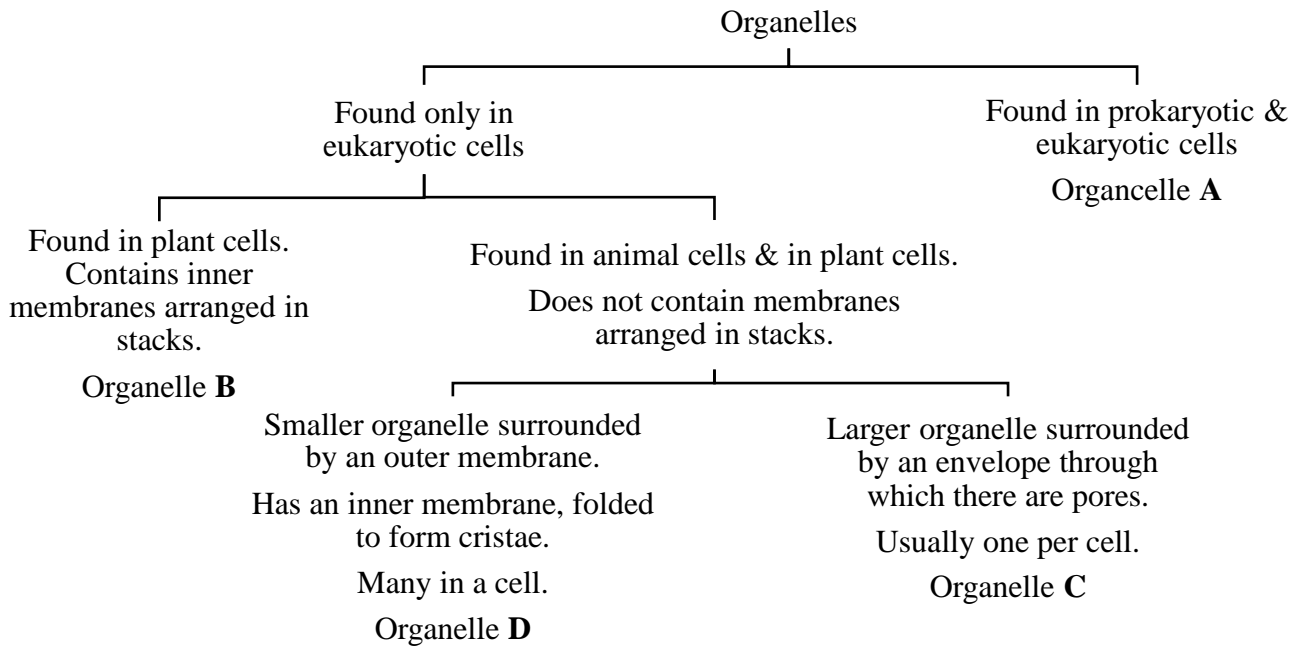
Instructions

- 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, 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 16 (6 marks)

The flowchart below shows how some organelles may be distinguished from each other.



a) Identify organelles **A** and **B**.

2

A = ribosome/cell membrane B = chloroplasts

Marking criteria	Marks
▪ Both answers are correct	2
▪ One correct answer provided	1

Marker’s comments:

A was not stipulated clearly that the organelle is made from protein & RNA so the expected answer is not exclusively ribosomes but can also be cell/plasma membrane; hence this answer was also accepted. Cytoplasm was not accepted as it is not considered to be an organelle.

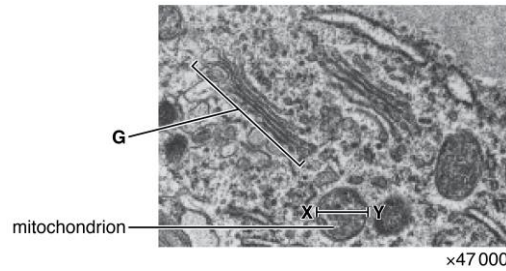
b) Relate the structure of organelle **B** to its function.

2

Organelle **B** is the site at which solar energy is captured and used to produce high energy molecules such as glucose. In order to do this efficiently, the chloroplast need to have a high surface area and this is achieved through the flattened membrane-bound compartments called thylakoids arranged in stacks called granum.

Marking criteria	Marks
▪ Answer states the function of the chloroplasts, i.e. for photosynthesis. – F ▪ Answer relates the need for a high surface area environment which is achieved through the stacks of thylakoids called granum. – S	2
▪ Any correct component of the answer is provided	1

The image below is an electron micrograph of part of a eukaryotic cell.



- c) Identify organelle **G** and state how it is possible to deduce that the image above is a transmission electron micrograph and not a scanning micrograph. **2**

Organelle **G** is a Golgi apparatus/body.

The image above is a transmission electron micrograph (TEM) as it produces 2D images of organelles and not 3D which is characteristic of scanning electron microscopy.

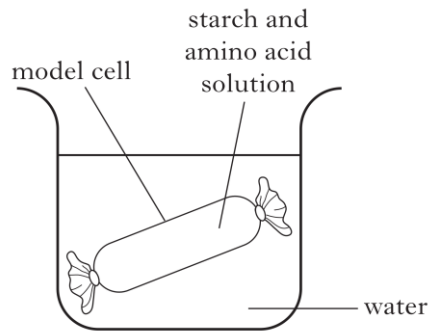
Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Answer identifies the organelles correctly – O ▪ Answer recognises the type(s) of images produced by SEM & TEM – M 	2
<ul style="list-style-type: none"> ▪ Any correct component of the answer is provided 	1

Marker's comments:

- Many students said that the image is of a TEM and not SEM due to the higher magnification that TEM can produce. While it is true that TEM can produce images of higher magnification/resolution, this answer is inaccurate in this instance. This is because SEM has a magnifying power of up to 50 000x and TEM of 2 000 000x and both are higher than 47 000x shown in the image.

Question 17 (4 marks)

A model cell was made using a dialysis tubing bag filled with a starch and amino acid solution. It was placed into a beaker of water and left for two hours.



- a) Amino acids were detected in the water outside the model cell but not starch. Suggest a possible explanation for this observation. 2

The amino acids must have been small enough to diffuse through the membrane of the model, which is selectively permeable by size. Starch is a macromolecule and must have been too large to cross the membrane and hence cannot be observed.

Marking criteria	Marks
<ul style="list-style-type: none">Answer recognises that the dialysis tubing must be selectively permeable by size – S₁Answer recognises that amino acids were small enough to cross the membrane and that starch was too large as it is a macromolecule – S₂	2
<ul style="list-style-type: none">Any correct component of the answer is provided	1

Marker's comments:

Students who said that the movement of amino acids must be due to osmosis, even if they said it travels down the concentration gradient when moving outside of the bag, were not awarded any marks as osmosis is due to the movement of water only.

- b) Predict what would happen to the mass of the model cell during the two-hour period. Explain your answer using appropriate scientific terminologies for any relevant phenomena/process. 2

The mass of the model cell will increase after the 2-hr period.

This is because starch and amino acid solution is hypertonic and the water outside the cell is hypotonic which causes water to move inside the model cell in a process called osmosis. Although amino acids would have diffused out, there is still starch inside the model cell and this will cause water to diffuse in.

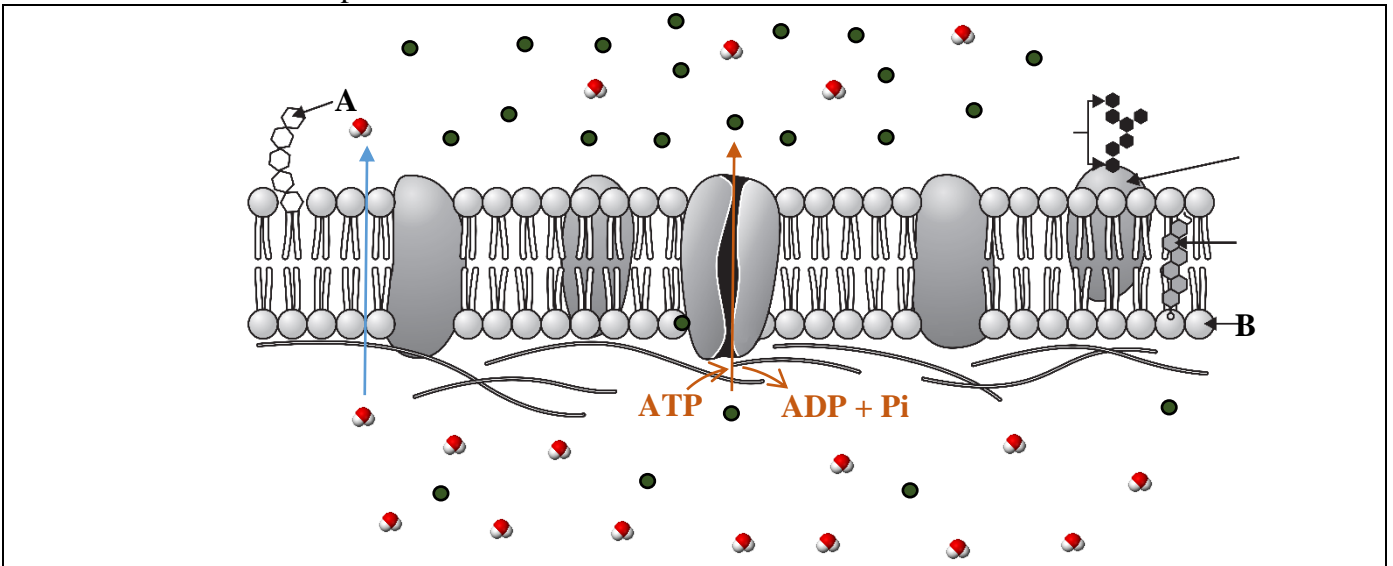
Marking criteria	Marks
<ul style="list-style-type: none">Answer recognises that the mass should increase – MAnswer recognises that water will move from a hypotonic area to a hypertonic area through a process called osmosis – O	2

▪ Any correct component of the answer is provided

1

Question 18 (6 marks)

Below is a section of the plasma membrane of an animal cell.



a) Identify components **A** and **B**.

2

A = glycolipid

B = phospholipid

Marking criteria	Marks
▪ One mark each	2

b) Annotate the diagram by the use of shapes, arrows and text to distinguish between active and passive transporting of substances across the membrane shown above.

2

Marking criteria	Marks
<ul style="list-style-type: none"> Diagram shows active transport occurs through the protein channel AND is going against concentration gradient AND requires the expenditure of energy. Diagram shows passive transport occurs down the concentration gradient AND does not require energy 	2
<ul style="list-style-type: none"> Any correct component of the answer is provided 	1

c) Justify why biological systems utilise both passive and active forms of transports.

2

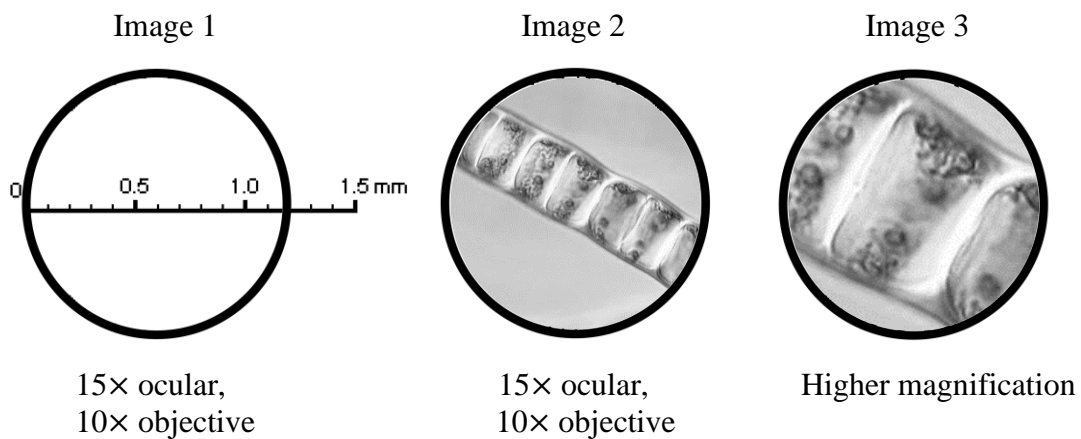
Biological systems utilise passive transport to move substances, such as water, across the membrane due to the lack of need for energy expenditure for this process. Passive transport can only move substances from an area of high concentration to an area of low concentration. This can be limiting as when concentrations across membrane reaches equilibrium, net movement stops. In some instances where the molecules are too large to cross the membrane lipid bilayer, such as the removal of ingested drugs, or if the substances must be moved across concentration gradient, active transport is needed.

Marking criteria	Marks
<ul style="list-style-type: none"> Answer stipulates that passive transports occur as it is a spontaneous process and does not require energy – P Answer stipulates that active transport is needed as net movement stops when equilibrium is reached and things such as wastes must be removed even if it is going against concentration gradient – A 	2
<ul style="list-style-type: none"> Any correct component of the answer is provided 	1

Question 19 (4 marks)

Each image below is of a whole field of view as seen under a microscope. In Images 1 and 2 an ocular lens of 15× and 10× objective lens were used. Image 3 was made using a higher magnification.

Drawing 1 shows a 1.5 mm scale in the field of view. Images 2 and 3 are of the same chain of cells in the alga *Ulothrix*.



a) Estimate the length (in μm) of one cell of *Ulothrix* in Image 2. Show your working. 2

At the same magnification of 150×: the FOV has a diameter of 1.2 mm and 6 full cells can fit across

$$1.2 \text{ mm} \div 6 \text{ cells} = 0.2 \text{ mm/cell}$$

$$1 \text{ mm} = 1000 \mu\text{m}$$

$$\therefore 0.2 \text{ mm} = 200\mu\text{m}$$

Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Answer calculated correctly ▪ Working out is shown 	2
<ul style="list-style-type: none"> ▪ Correct process for working out is shown but wrong answer is provided <p>OR</p>	1

▪ Answer is provided without working out

b) Calculate the diameter of the field of view (in μm) and the magnification of Image 3.

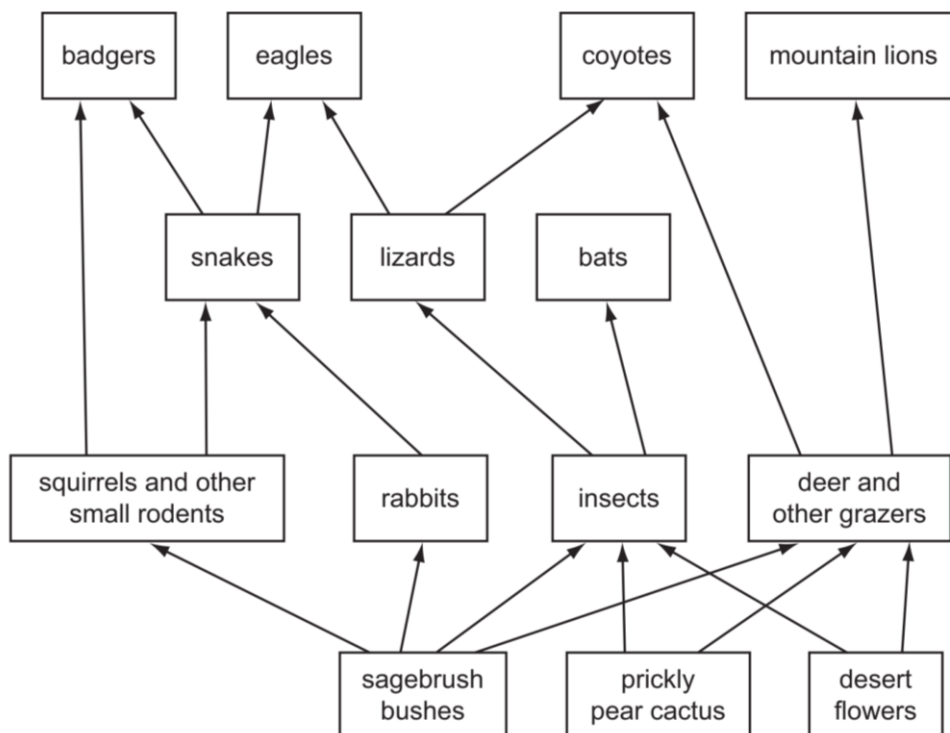
2

- At $150\times$ magnification (15×10) 6 full cells can be observed & the FOV is $1200\ \mu\text{m}$.
- At higher magnification 2 full cells can be observed this is $\frac{1}{3}$ of what can be observed at $150\times$, this means that the diameter of the FOV is also $\frac{1}{3}$ of $1200\ \mu\text{m}$.
- Thus, the diameter is **$400\ \mu\text{m}$** and the magnification is $3(150\times) = 450\times$
- Alternatively, because only $\frac{1}{3}$ of Image 2 is seen in Image 3, this makes the magnification of Image 3 three times larger than Image 2. Therefore, $3(150\times) = 450\times$.

Marking criteria	Marks
<ul style="list-style-type: none">▪ Answer calculated the diameter of the FOV = $400\ \mu\text{m}$ <u>OR</u> the answer is a number that is twice the answer provided in part (a) (carryon error).▪ Answer calculated the magnification of Image 3 is $450\times$	2
<ul style="list-style-type: none">▪ Any correct component of the answer or process (due to carryon error) is provided	1

Question 20 (6 marks)

The figure below shows the biotic interactions in a community.



a) Distinguish between a food web and a food chain.

2

A food chain shows the feeding relationship between organisms of differing trophic levels whereas a food web shows the relationship of multiple interconnecting food chains present in a community.

Marking criteria	Marks
<ul style="list-style-type: none"> Answer correctly contrasts food chain from food web. 	2
<ul style="list-style-type: none"> Any correct component of the answer is provided 	1

b) Name a consumer from the 2nd trophic level shown in the figure above.

1

2nd trophic level = first order consumer.

Answer is any of the following: **deer and other grazers, insects, rabbits, squirrels and other small rodents**

Marking criteria	Marks
<ul style="list-style-type: none"> Any one of the following is provided: deer and other grazers, insects, rabbits, squirrels and other small rodents 	1

c) In some regions, deer and other grazers have been hunted and face extinction. Suggest how the extinction of deer and other grazers would affect other animals in this community.

3

If the deer and other grazers population decrease or face extinction, this will wipe out the only food source for the mountain lions.

As a result, the mountain lion's population will decrease and also face extinction. The coyotes also feed on deer and other grazers but because they have other food sources in the form of lizards, although their population may drop, they will not be too affected.

The other animals other than the coyotes and mountain lions will benefit from the removal of the deer and other grazers as their absence allow the producers in the first trophic level to increase in numbers due to decreased competition, increasing food abundance for other animals so their population should increase.

Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Answer suggests a negative impact for the mountain lions – L ▪ Answer suggests minimal impact on the coyotes – C ▪ Answer suggests a positive impact for other animals – OA 	3
<ul style="list-style-type: none"> ▪ Any two of the above 	2
<ul style="list-style-type: none"> ▪ One of the above 	1

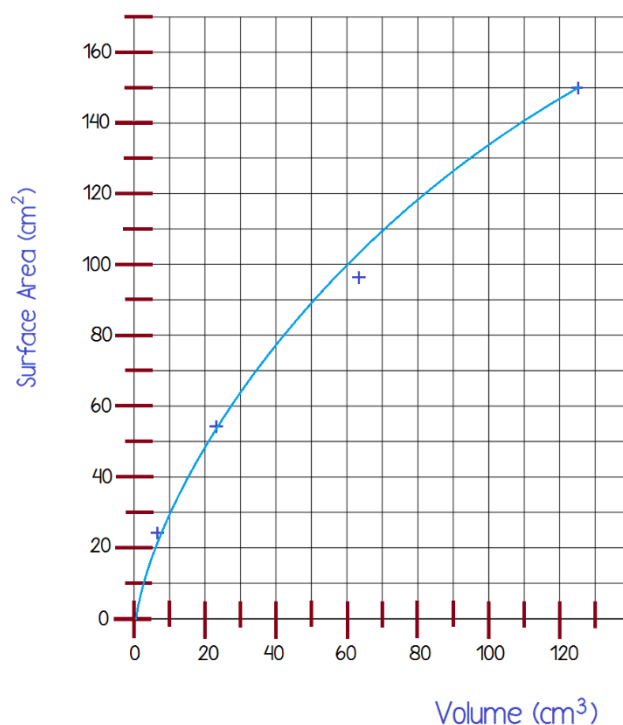
Question 21 (6 marks)

The table below shows the surface area and volume for four different-sized potato cubes

Potato Cubes		
Cube Size (cm)	Surface Area (cm ²)	Volume (cm ³)
2	24	8
3	54	24
4	96	64
5	150	125

a) Graph the volume of each cube against its surface area using the same increment for X & Y-axes. **3**

Relationship between SA vs Volume of different sized potato cubes



Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Graph has an appropriate title and labelling (volume on X-axis & SA on Y-axis) – T ▪ Graph is plotted correctly and is showing the correct trend using equal increments – P ▪ Graph is drawn using a solid line with no feathering – G 	3
<ul style="list-style-type: none"> ▪ Any two of the above 	2
<ul style="list-style-type: none"> ▪ One of the above 	1

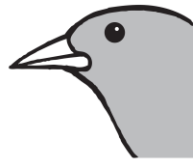
b) Use the information shown in graph to justify the adaptation of the size of cells. **3**

It can be observed from the graph that as the volume of the cell increases, the rate of surface area increase decreases (**G**). The size of cells have adapted to be very small so that it can have a high SA:V ratio (**SA:V**). This is to ensure the transportation of substances into and leaving the cell can be at an adequate rate to ensure metabolic needs are met and waste removal can be at a sufficient rate (**N**).

Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Answer refers to the trend observed from the graph – G ▪ Answer suggests the smaller the cell the higher the surface area: volume ratio – SA:V ▪ Answer thoroughly relates the high SA:V to the needs of cells explicitly – N 	3
<ul style="list-style-type: none"> ▪ Any two of the above 	2
<ul style="list-style-type: none"> ▪ One of the above 	1

Question 22 (7 marks)

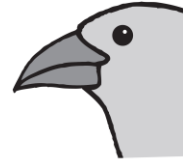
The diagrams below show three species of finches which live on the Galapagos Islands as observed by Charles Darwin on his voyage.



Feeds on insects



Feeds on seeds



Feeds on seeds

a) Explain why these finch species occupy different niches.

2

These finches occupy different niches due to their differing beak size/types allowing them to access food available in their ecological niche. The long narrow beak allows the finch to conveniently collect insects whereas the shorter but wider beak type allows the finch to crack seeds open and feed on them.

Marking criteria	Marks
<ul style="list-style-type: none">Answer relates the beak size to ability to access the food available in the ecological niche – BAnswer refers to the information provided – R	2
<ul style="list-style-type: none">One of the above	1

- b) Explain, using examples, how Darwin and Wallace’s Theory of Evolution by Natural Selection accounts for convergent evolution.

3

Darwin and Wallace’s Theory of Evolution by Natural Selection suggests that individuals of a population will have physical traits (adaptations) that will allow them to overcome the selection pressures of that environment to successfully obtain the resources they need and eventually reproduce; passing on those adaptations to their offspring. This process is called natural selection.

Convergent evolution occurs when distantly related species share similar ecological niches and face similar selection pressures, they go on to evolve similar physical traits for similar purposes and this trait was not observed in their last common ancestor.

Convergent evolution can be observed in sharks and dolphins. These two species diverged from a common ancestor a very long time ago with sharks being classed as Fish as they are ectothermic and breathe using gills, and dolphins are classed as Mammalia as they are endothermic and breathe using lungs. Due to shared environmental niche, that is the marine environment, both species have evolved to have streamlined bodies for ease of movement in water as it is denser than air and both have fins to navigate and travel in water effectively.

Marking criteria	Marks
<ul style="list-style-type: none">Answer describes Darwin & Wallace’s Theory of Evolution by means of Natural Selection – EAnswer explains what convergent evolution is – CAnswer uses an appropriate example to demonstrate convergent evolution – E	3
<ul style="list-style-type: none">Any two of the above	2
<ul style="list-style-type: none">One of the above	1

- c) Some areas on the islands have a thin layer of soil and low rainfall. Describe an adaptation that can be observed in plants native to these areas that will help them survive.

2

Adaptations that can assist plants living in areas of low rainfall and with thin soil layer includes:

- **Wide network of shallow root system** allowing the plant to maximise water uptake from the soil. That way, they can take advantage of rain that's more inclined to run off than to penetrate the rocky/dry soil.
- **Deep tap roots as well as shallow roots** to allow the plant to absorb as much water as possible from the surface soil layer after rainfall and to access the water from lower soil layers when rainfall is inadequate.
- **Reduced leaf structure** that can turn into spines or just really long and narrow. That way, less evaporation is going to take place while the plant photosynthesize, reducing water demands.
- **Plant tissues** that can hold onto water like a sponge maximising the amounts of water uptake and availability after the rain.
- **Thick, waxy, cuticle** that will allow the plant to prevent dehydration through evaporation. Allowing water retention in cells to increase, preventing water loss.
- **Night adaptions** such as blooming flowers at night so the flower don't shrivel and dehydrate under the Sun during the day. Or, the ability to carry out CAM photosynthesis where the stomates only open at night for CO₂ absorption which can be used for photosynthesis during the day without the need for stomates opening to prevent transpiration.

Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Answer identifies an adaptation for water conservation or uptake – A ▪ Answer describes how the adaptation allow the plant to minimise water loss or to maximise water uptake – R 	2
<ul style="list-style-type: none"> ▪ One of the above 	1

Question 23 (2 marks)

Some oceans surrounding Australia lack nutrients compared with other oceans. Australian fur seal pups are suckled for longer and develop at a slower rate than seal pups in other parts of the world.

2

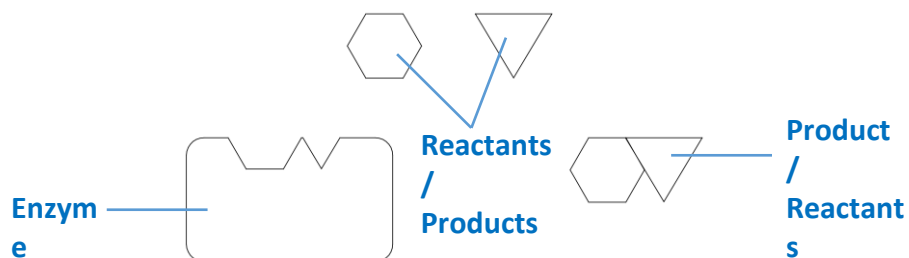
Suggest why this strategy is useful for survival.

Australian fur seal pups develop at a slower rate than seal pup in other parts of the world to reduce the demand for nutrients. And since they suckle for longer, they can meet their nutritional needs through both the environment and mother to ensure they have enough nutrients to grow adequately in the low nutrient Australian ocean.

Marking criteria	Marks
<ul style="list-style-type: none">Answer accounts for why the Australian fur seal pups develop slower – DAnswer accounts for why the Australian fur seal pups suckle for longer – S	2
<ul style="list-style-type: none">One of the above	1

Question 24 (3 marks)

The diagram below shows a model of how an enzyme works.



a) Label the components shown in the diagram.

1

b) Justify the importance of enzymes in biological systems.

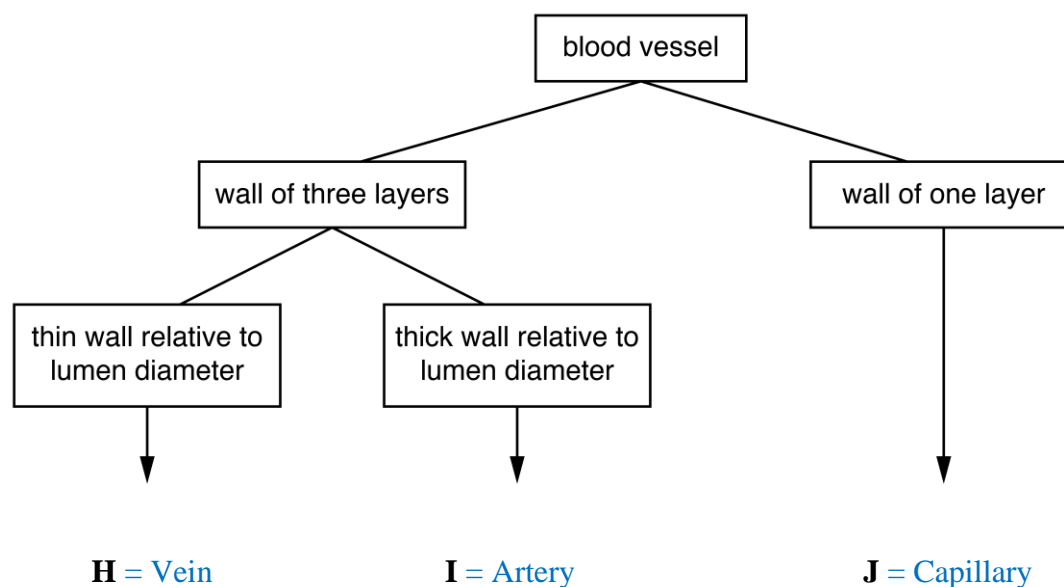
2

Enzymes are important in biological systems because they are biocatalysts and they control the rate of metabolic reactions in the body. Enzymes can control how much of a product is being produced from a chemical reaction to meet the needs of cellular function. Otherwise, the reaction is reliant on spontaneity may be too slow to meet the demands of cells which could lead to cell death and organ failure and eventually the development of disease or death in the organism.

Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Answer identifies the role of enzymes as to control the rate of biological reactions – R ▪ Answer accounts for the controlling of reactions is to meet the needs of cells – N 	2
<ul style="list-style-type: none"> ▪ One of the above 	1

Question 25 (7 marks)

The diagram below shows features that are observed in transverse sections of three types of blood vessel.



- a) Complete the diagram above by identifying the type of blood vessel indicated by **H** and **J**. 2
- b) Explain how the structure of **I** is related to its function 2

It is an artery. The artery has a thick wall relative to its lumen and this is to maintain blood pressure as it is pumped away from the heart. As the blood being pumped away from the heart is under high pressure, the artery's thick wall can withstand this pressure and prevent bursting (1) as well as delivering blood to capillaries at the high pressure that it needed to allow content in blood to permeate across the cell membrane (2).

Marking criteria	Marks
▪ Answer relates the structure to 2 functions correctly – F1 & F2	2
▪ One of the above	1

c) With the use of examples, compare an open circulatory system to a closed circulatory system.

3

Feature	Open Circulatory System	Closed Circulatory System
Transport Medium	Haemolymph	Blood
Transport Vessel	Open system (unlooped). Transport medium flows in and out of vessels	Closed system (loop). Transport medium flows within a network of vessels.
Blood mixing	The extracellular fluid mixes with the transport medium	The extracellular fluid does not mix with the transport medium.
Energy requirement	Less	More
Pressure	Blood does not flow under pressure	Blood flows under pressure through heart pumping

Examples	Common in molluscs & arthropods	Common in vertebrates
----------	---------------------------------	-----------------------

Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Any 3 features compared correctly – C1, C2, C3 	3
<ul style="list-style-type: none"> ▪ Two of the above 	2
<ul style="list-style-type: none"> ▪ One of the above 	1

Question 26 (4 marks)

The fossil below was discovered by South African palaeontologist Billy de Klerk near a small town in Grahamstown's region in 2005. The fossil is of a relatively small dinosaur species called *Heterodontosaurus tucki*, weighing between 2-10 kg, and is believed to be 200 million years old.



Source: <http://www.geologyin.com/2016/08/x-rays-reveal-secrets-of-tiny-dinosaur.html>

- a) Using the fossil record shown, predict the type of diet consumed by the *Heterodontosaurus tucki*. **1**

The [Heterodontosaurus tucki](#) is a herbivorous dinosaur.

Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Correct answer is provided 	1

- b) Comment on two features that might be observable in the alimentary canal of the *Heterodontosaurus tucki*. Justify your answer. **3**

The alimentary canal of this dinosaur must be long relative to its body size and complex, exhibiting multi-chambered stomach and/or with a very long caecum present.

The long alimentary canal, specifically the intestine, allows the dinosaur to retain the food inside as long as possible to maximise absorption. This is because plant-based food are not dense in energy when compared to meat-based food.

Furthermore, since plant cells contain cellulose which is difficult to digest, the presence of a complex stomach will allow it to further grind the cellulose in plants and caecum will contain bacteria that can break down cellulose allowing the dinosaur to access the nutrients in plants.

Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Answer identifies the long alimentary canal relative to its body &/or the complex stomach or/& caecum – S1 & S2 ▪ Answer relates each of the features provided with its function based on diet – F1 & F2 	3
<ul style="list-style-type: none"> ▪ Two of the above 	2
<ul style="list-style-type: none"> ▪ One of the above 	1

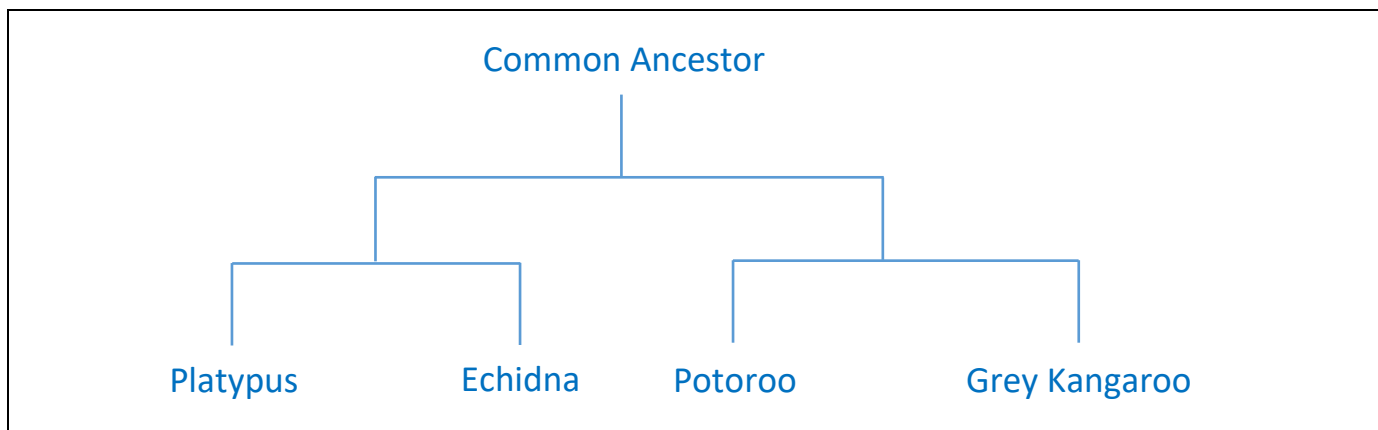
Question 27 (5 marks)

The table below shows comparisons between the amino acid sequences in the DNA of the echidnas, grey kangaroo, platypus and potoroo.

Pairs of organisms	Number of amino acid differences
Platypus – Grey Kangaroo	35
Platypus – Echidna	10
Platypus – Potoroo	32
Echidna – Potoroo	29
Echidna – Grey Kangaroo	34
Potoroo – Grey Kangaroo	11

a) Draw a tree to show the evolutionary relationship between the organisms in the table.

2



Marking criteria	Marks
<ul style="list-style-type: none"> Tree shows correct evolutionary relationships between Echidnas–Platypus & Potoroo–Grey kangaroo Tree shows all four species stemmed from a common ancestor and they went through at least 2 speciation events 	2
<ul style="list-style-type: none"> Any correct component of the answer provided 	1

b) Explain your reasoning with specific reference from the data.

3

All four species share a common ancestor as they all have very little degree of differences in their amino acid sequences, suggesting the ‘original’ amino acid sequence was inherited through this common ancestor. However, mutation would have occurred to these amino acid sequences, giving rise to the differences but these should occur at a predictable rate which can indicate how recent any two species diverged from each other in the evolutionary process. There are only 10 differences in amino acid sequence between the Platypus & Echidna and 11 between the Potoroo & Grey Kangaroo. This suggests they share a more recent common ancestor with each other compared to others as their amino acid sequences are highly similar as opposed to Platypus – Grey Kangaroo with 35 amino acids difference.

Marking criteria	Marks
<ul style="list-style-type: none"> ▪ Answer suggests the degree of differences in amino acid = relatedness – D ▪ Answer suggests that the differences arise in a predictable rate which informs us of how long ago the species diverged from each other – L ▪ Answer refers to the data provided – R 	3
<ul style="list-style-type: none"> ▪ Two of the above 	2
<ul style="list-style-type: none"> ▪ One of the above 	1

End of examination