Student Number _____

MC /20	Mol /28	Zois /27	Total /75

Sydney Technical High School

Student Name _____

Teacher _____

2020

PRELIMINARY COURSE EXAMINATION

Biology

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black or blue pen
- Draw diagrams and graphs using pencil
- Approved calculators may be used
- Write your student number in the space provided

Total marks – 75

This paper has two parts, Part A and Part B

Part A – 20 marks
- Attempt Questions 1-20
- Allow about 35 minutes for this part

Part B – 55 marks
- Attempt Questions 21- 31
- Allow about 1 hour and 25 minutes for this part

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Student Number _____

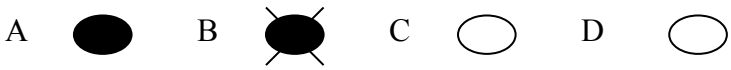
Part A – 20 marks
Attempt Questions 1-20
Allow about 35 minutes for this part

Use the multiple-choice answer sheet.

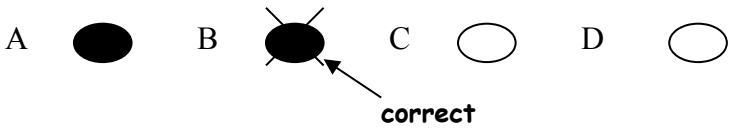
Select the alternative A,B,C or D that best answers the question. Fill in the response oval completely.

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

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



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



Student Number _____

PRELIMINARY EXAMINATION

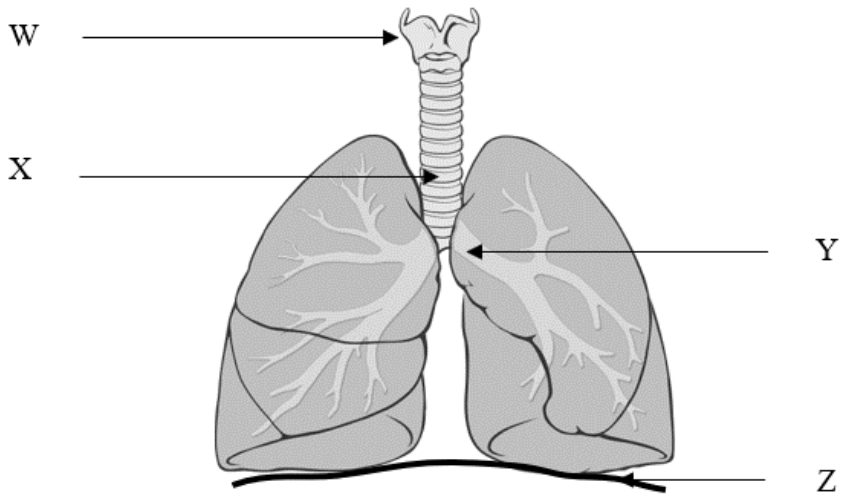
Biology

Multiple Choice Answer Sheet

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 ◯

Student Number _____

1. The diagram below shows the human respiratory system.



Choose the line in the table below which correctly identifies the labelled structures.

	W	**X**	**Y**	**Z**
(A)	trachea	larynx	bronchus	diaphragm
(B)	diaphragm	larynx	trachea	bronchus
(C)	larynx	trachea	bronchus	diaphragm
(D)	trachea	bronchus	diaphragm	larynx

2. Which one of the following is NOT an aspect of biodiversity?

(A) The variety of different species.

(B) Genetic diversity within a species.

(C) The variety of different climates.

(D) The diversity of different ecosystems.

3. Some vertebrate embryos are shown below.

They are all very similar in structure.

This similarity is due to:

(A) convergent evolution

(B) divergent evolution

(C) punctuated equilibrium

(D) common ancestry.

4. Which one of the following is found in unicellular organisms?

(A) tissues

(B) organs

(C) organ systems

(D) organelles

5. Which one of the following is essential for natural selection to occur?

(A) large population

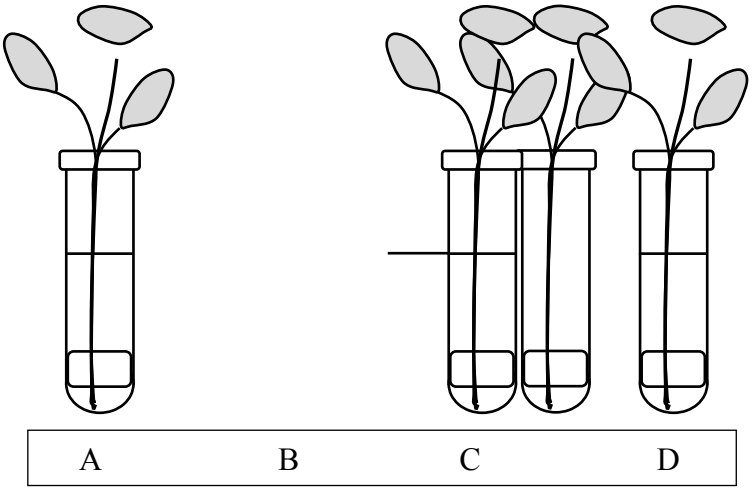
(B) genetic variation

(C) some individuals not reproducing

(D) some individuals living longer than others

Student Number _____

Questions 6 and 7 refer to the diagram below. It shows four identical leafy shoots placed in test tubes of water to investigate how different factors affect transpiration.



They were subjected to different conditions as outlined in the table below.

Tube	Air temperature (^{o}C)	Wind speed (kmhr^{-1})	Humidity (%)
A	10	0	75
B	15	10	50
C	10	15	25
D	15	10	0

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

(A) A

(B) B

(C) C

(D) D

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

(A) A and B

(B) B and C

(C) B and D

(D) C and D

8. Which of the following events would lead to punctuated equilibrium?

(A) Slow increasing aridity of inland Australia.

(B) A slow rise in global temperatures.

(C) Cretaceous extinction of the dinosaurs.

(D) Plate tectonics causing plate divergence.

9. What happens in the large intestine?

(A) Proteases begin the digestion of protein.

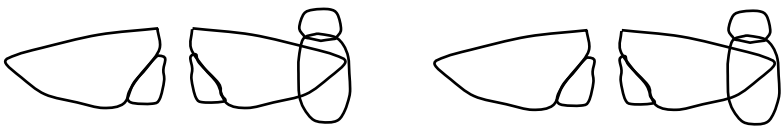
(B) Absorption of digested food begins.

(C) Amylase begins starch digestion.

(D) Water is absorbed.

10. During the nineteenth century, in Europe, Peppered Moths underwent a microevolutionary change.

Over the course of just a few decades they changed from being grey in colour to being black.



Industrial pollution killed the grey lichen on the trees, causing the trunks to become black. Grey moths were now no longer camouflaged and were eaten by birds. Black ones were camouflaged and were eaten less frequently.

Which of the following is the selecting agent?

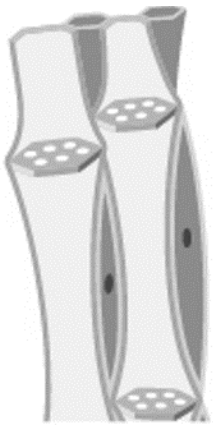
(A) lichen

(B) birds

(C) industrial pollution

(D) tree trunks

11. The drawing below is a longitudinal section of a type of plant transport tissue.



Identify the tissue.

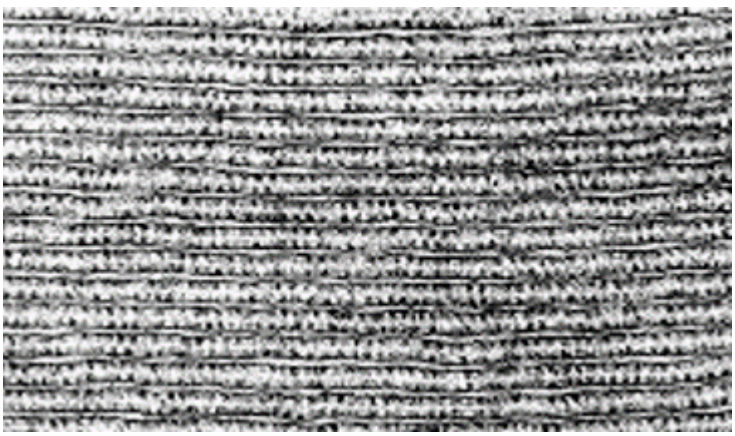
(A) phloem

(B) cortex

(C) cambium

(D) xylem

12. Identify the main function of the cell structure shown below.



(A) photosynthesis

(B) protein synthesis

(C) duplication of hereditary material

(D) aerobic respiration

13. In which form is energy available to do work in cells.

(A) ATP

(B) glucose

(C) oxygen

(D) enzymes

14. The divided bar graph below shows the relative abundance of four major vegetation types across Australia 50,000 years ago.

What type of evidence would have been most useful in helping scientists to deduce this?

(A) radiometric dating

(B) fossil evidence

(C) aboriginal rock paintings

(D) gas analysis

15. On the Great Barrier Reef, Clown Fish can be regularly seen swimming in and around Sea anemones. The anemone provides shelter and protection for the fish and the Clown fish provides nutrients for the anemone.

This relationship is an example of:

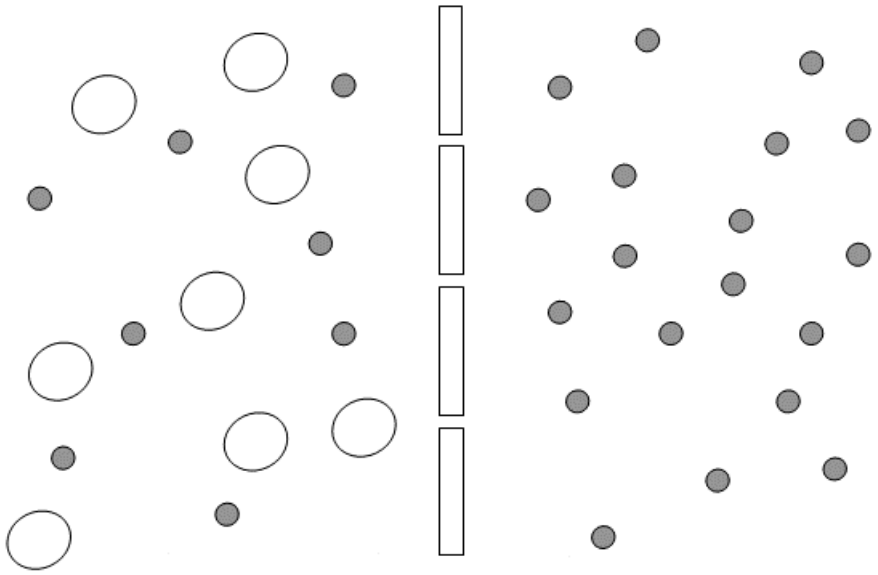
(A) Commensalism

(B) Mutualism

(C) Parasitism

(D) Predation

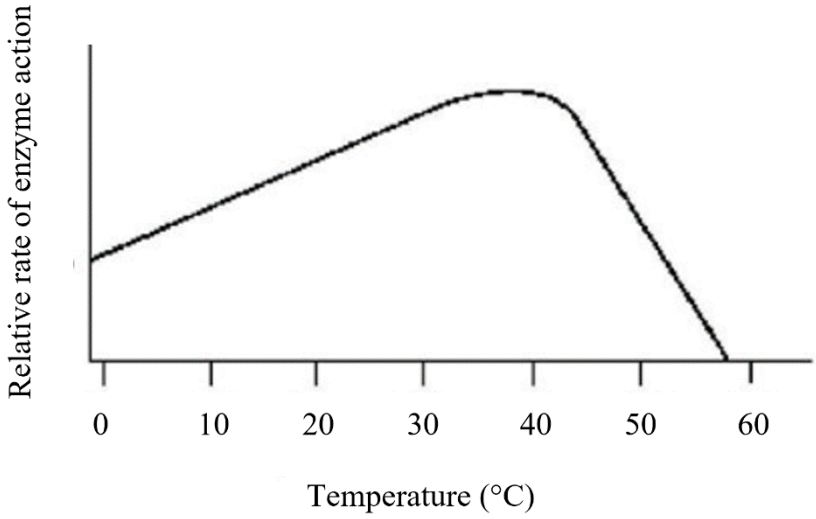
16. The diagram below shows a semi-permeable membrane with glucose and water molecules to the left and water molecules to the right.



Choose the row of the table below which best describes what would happen.

	Glucose molecules	Water molecules
(A)	Move from left to right until equally distributed on both sides	Move in both directions until evenly distributed on both sides
(B)	Move from left to right until equally distributed on both sides	Move from right to left.
(C)	Remain on the left side	Move in both directions until evenly distributed on both sides
(D)	Remain on the left side	Move from right to left.

17. The diagram shows the effect of temperature on the relative rate of enzyme action.



What is the approximate optimum temperature for the action of this enzyme?

(A) 15 °C

(B) 22 °C

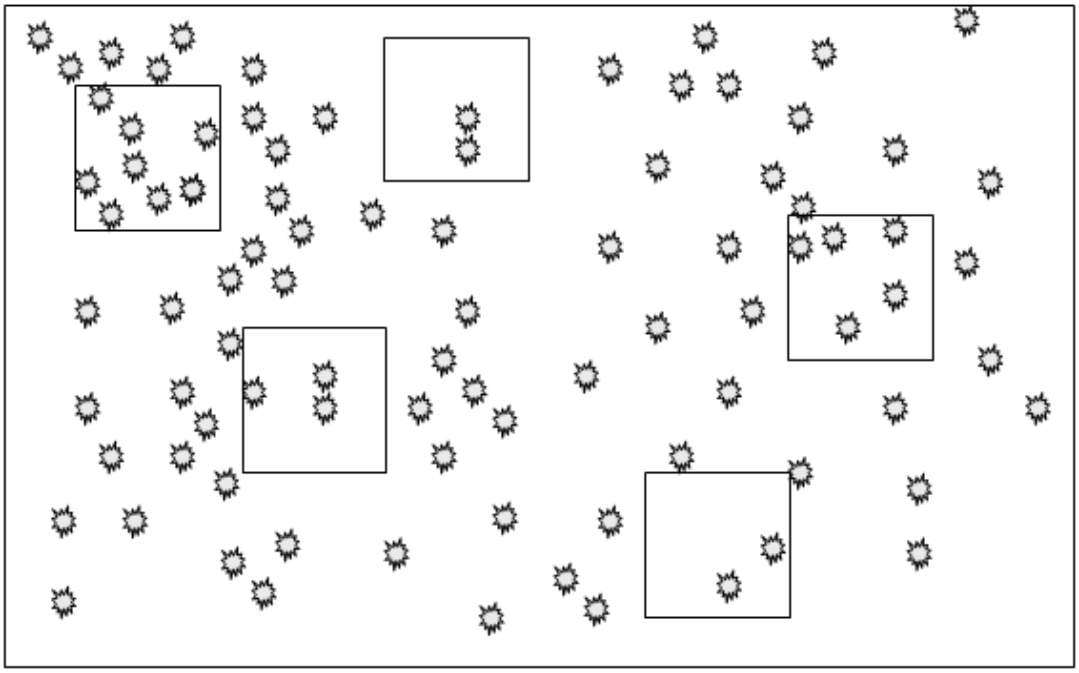
(C) 37 °C

(D) 50 °C

Student Number _____

Questions 18 and 19 refer to the map below.

The map shows the distribution of salt bush in an area of semi desert.



18. Some biologists have randomly placed five quadrats as shown above. Each quadrat measures 10m x10m.

From these quadrats the population density of salt bush in this area is:

(A) 100 bushes/100m^2

(B) 20 bushes/100m^2

(C) 5 bushes/100m^2

(D) 4 bushes/100m^2

19. How could the reliability of this measure be improved?

(A) Count the bushes more carefully.

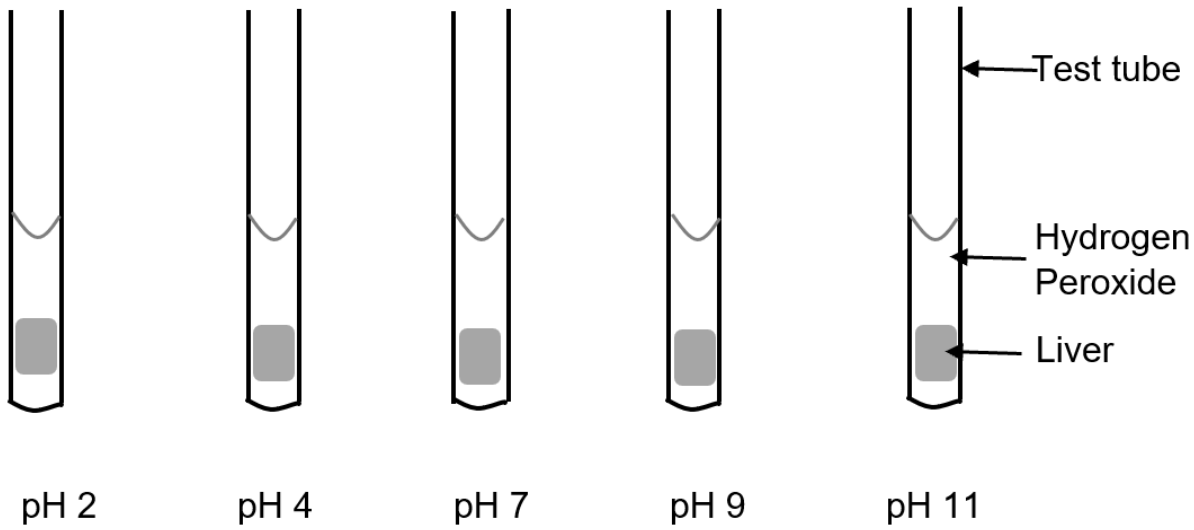
(B) Place quadrats evenly in areas with high and low densities of salt bush.

(C) Use smaller quadrats

(D) Use more quadrats

20. The enzyme catalase is found in liver tissue in mammals.
It speeds up the removal of hydrogen peroxide from the body by converting it to water and oxygen.

A student set up the following investigation to determine if pH affects the rate at which catalase converts hydrogen peroxide to water and oxygen.



Which of the following would be a controlled variable in this investigation?

(A) Liver from 5 different mammals.

(B) Changing the pH.

(C) The amount of oxygen bubbles produced.

(D) The temperature at which the investigation is conducted.

Student Number _____

Part B – 55 marks

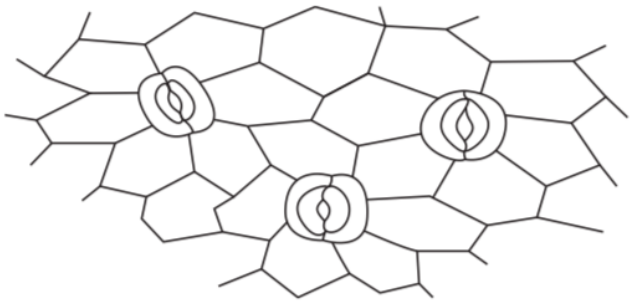
Attempt Questions 21 –31

Allow about 1 hour and 25 minutes for this part
Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Molino	Marks /28

Question 21 (5 marks)

A student compared the number of stomata on the upper and lower surfaces of a leaf.
The student drew a biological diagram of the leaf peel taken from the underside of the leaf, shown below.



(a) The student observed that the stomata were open. **3**

Describe how stomata open.

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Question 21 continues on the next page

Question 21 continued

(b) The leaf peel from the upper surface of the leaf showed no stomata. **2**

Explain why it is an advantage to the plant to have this distribution of stomata in the upper and lower surfaces of the leaf.

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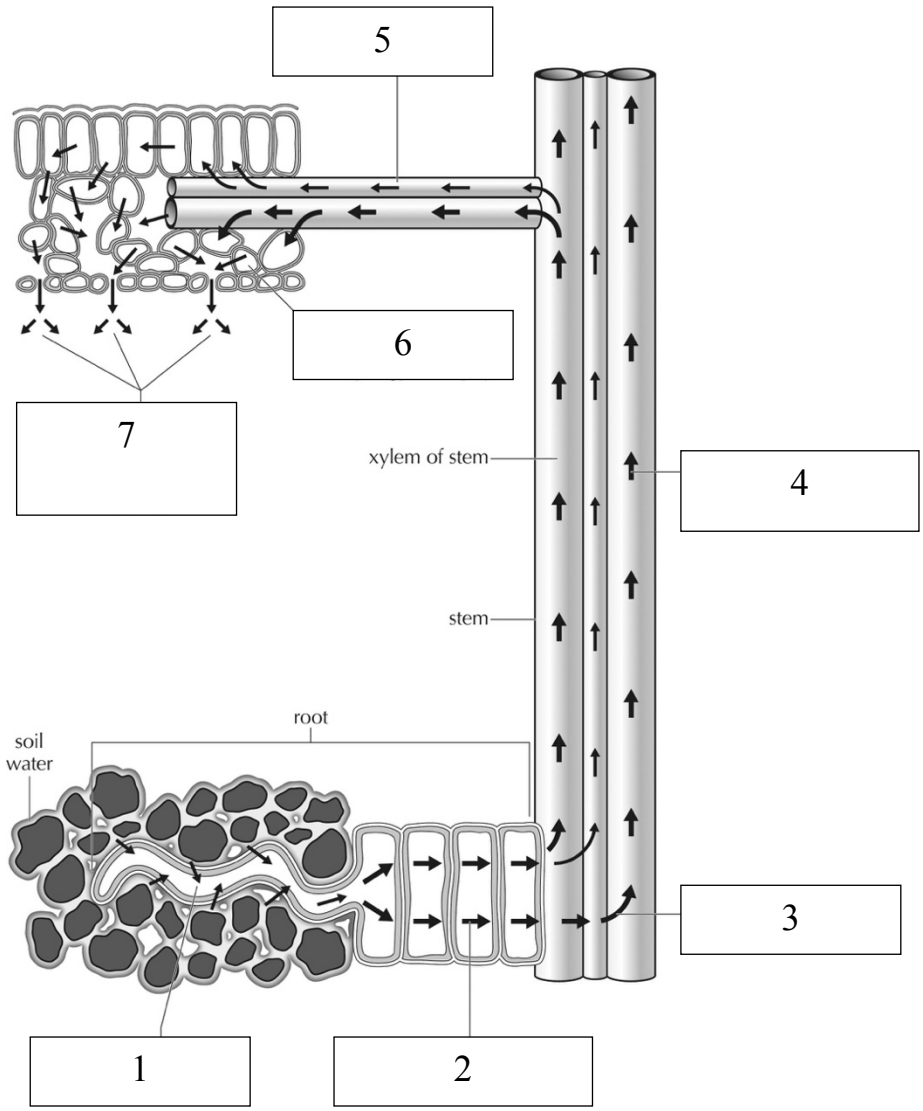
Student Number _____

Question 22 (5 marks)

Using the diagram below, describe how water is moved through a plant by transpiration by filling out the table provided.



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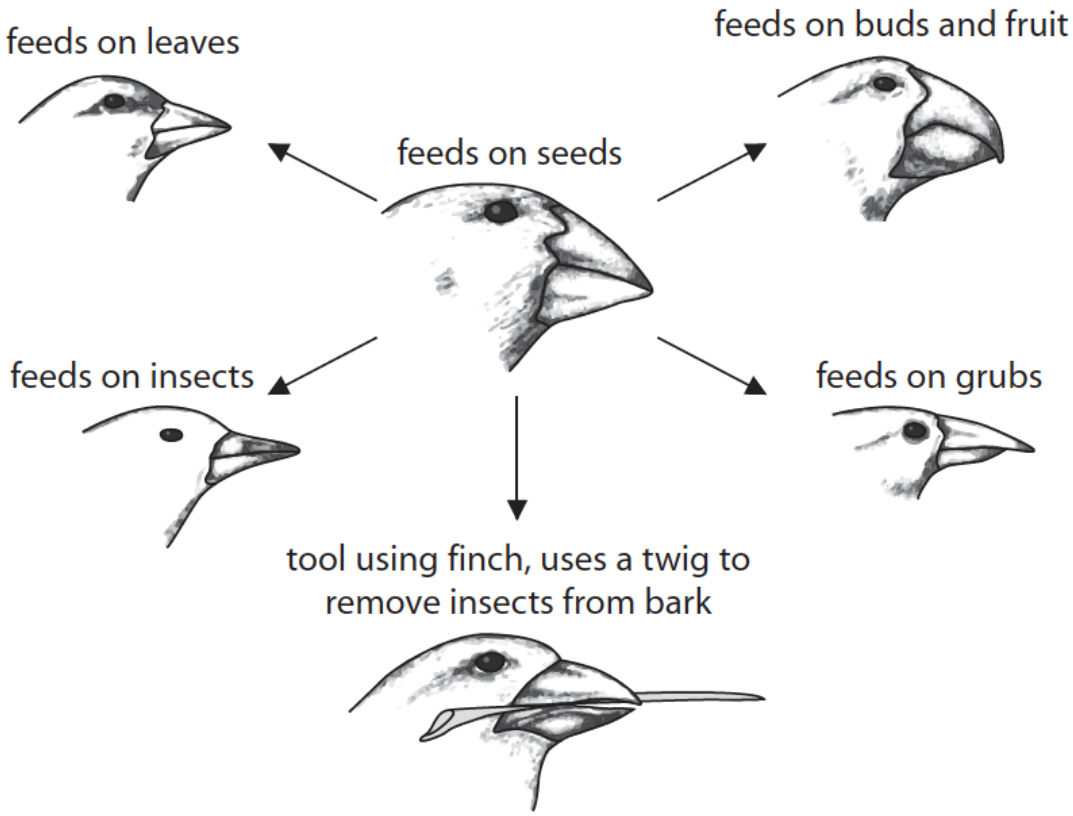
STEP	DESCRIPTION
1	**……** **……** **…** **……**
2	**……** **……** **……**
3	**……** **……** **……**
4	**……** **……** **……**
5	**……** **……** **……**
6	**……** **……** **……**
7	**……** **……** **……**

Student Number _____

Question 23 (3 marks)

Charles Darwin studied finches on the Galapagos Islands.
The diagram shows the beak shapes and the food source of some of these finches.



Explain using the theory of natural selection how these different beak shapes of finches came to be.

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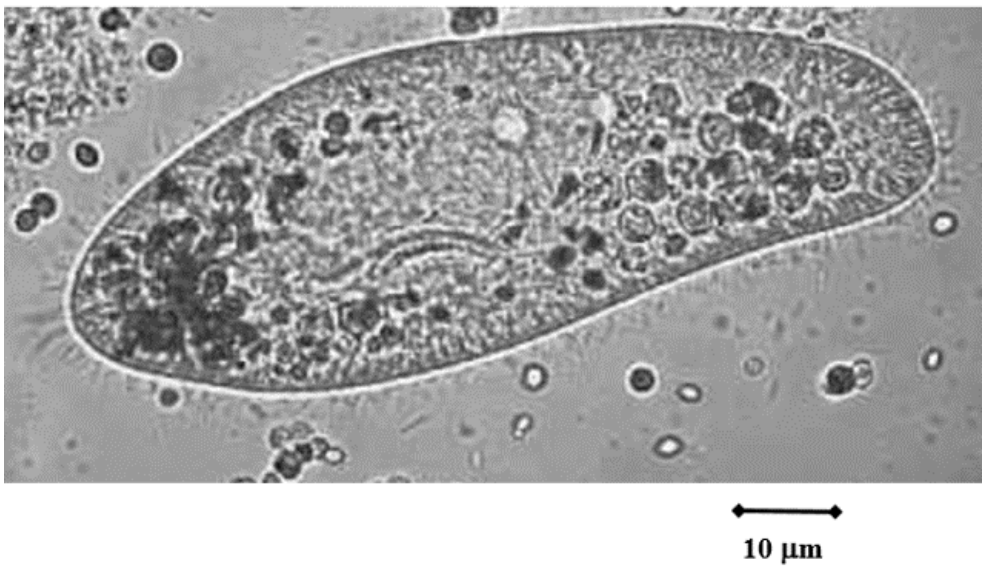
Student Number _____

Marks

Question 24 (11 marks)

The photograph below shows a type of *Paramecium*.



(a) Determine the length of this specimen. **1**

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(b) Paramecium is a unicellular organism.

Discuss the advantages and disadvantages to an organism of being unicellular or multicellular.

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Marks

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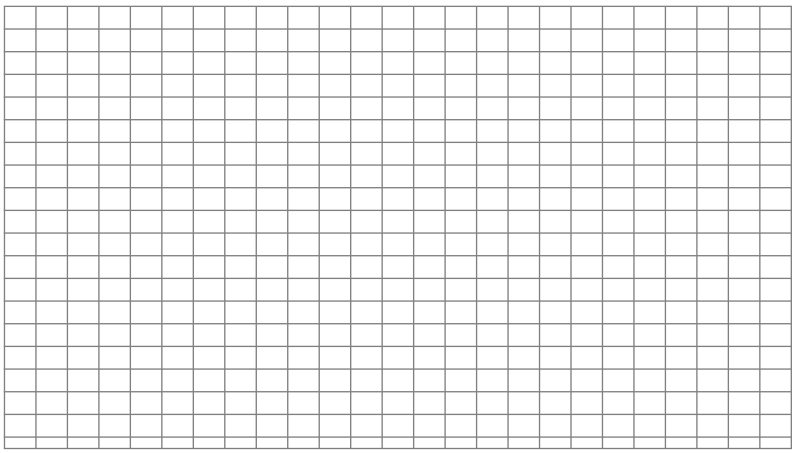
Question 24 continues on the next page

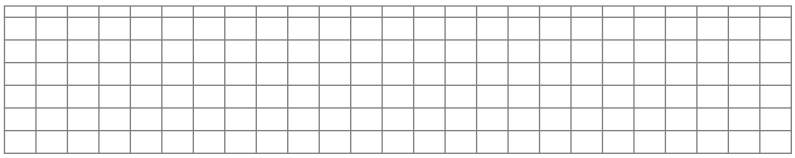
Question 24 (continued)

The table below shows how the numbers of two species of *Paramecium* vary over the course of several months after they are introduced into an aquarium.

Time (days)	Number of individuals per 100mL.	
	P. caudatum	***P. aurelia***
0	5	5
3	15	18
5	12	28
10	3	40
12	1	47
15	0	51

(c) Use the grid below to graph the populations of these two species, on the same graph. **3**





Question 24 continues on the next page

Question 24 continued

(d) Identify the type of ecological relationship shown here and explain how the populations affect each other. **3**

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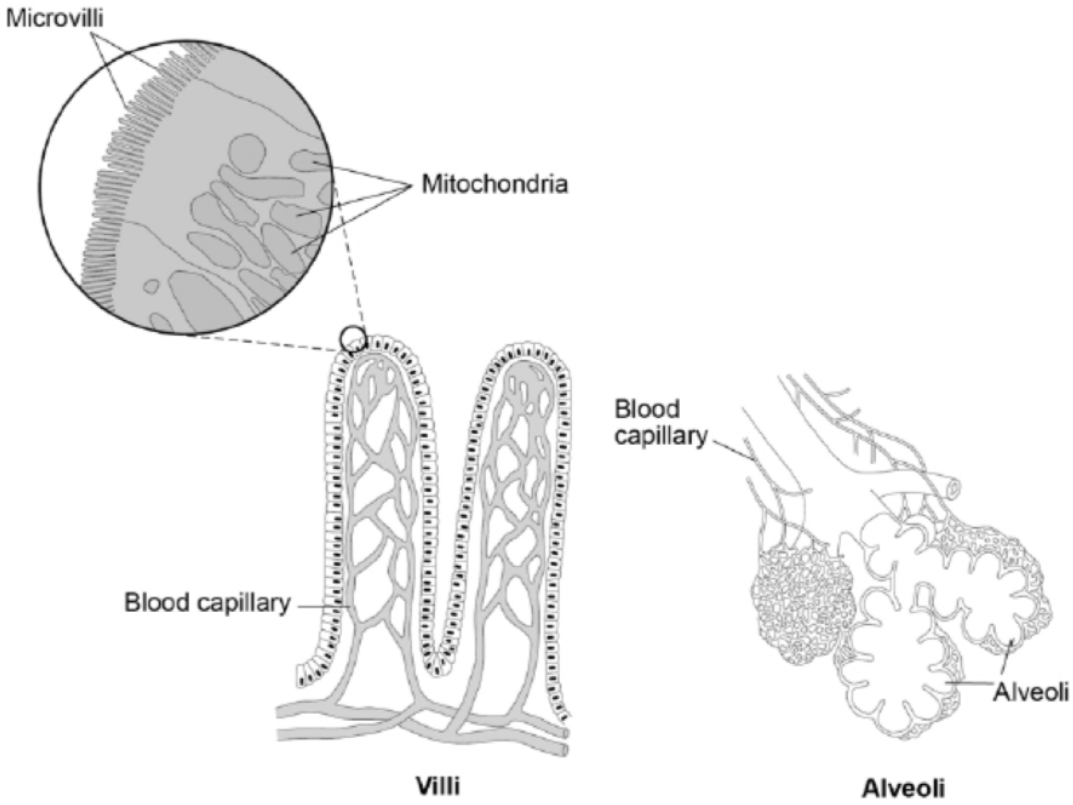
Question 25 (4 marks)

The digestive system and the breathing system both contain specialised exchange surfaces.
In the digestive system, digested food is absorbed into the blood stream in structures called villi.
In the breathing system, gases are absorbed into the blood stream in the alveoli.

The diagram below shows the structure of villi and alveoli.

Student Number _____



Explain how the villi and the alveoli are adapted to absorb molecules in the bloodstream. **4**

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Question 21-25 Extra writing space.

If you use this space clearly indicate which questions you are answering.

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Student Number _____

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Zois	Marks /27

Question 26 (7 marks)

(a) Draw an annotated diagram of the fluid mosaic model of the cell membrane. **4**

(b) Explain how the fluid mosaic model accounts for movement of substances into and out of the cell

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Question 27 (4 marks)

The organelle in the photograph below is the site of photosynthesis in plant cells.

Student Number _____

(a) Name the organelle. **1**

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2

(b) Fill in the boxes below to give the word equation for photosynthesis.

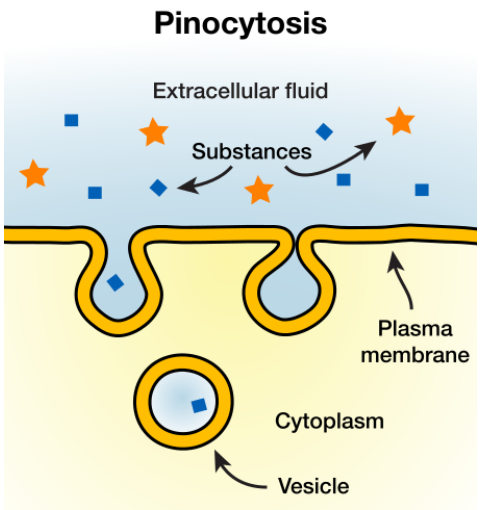
1

(c) One factor which affects the rate of photosynthesis is light intensity.

Sketch a line on the axes below to show the relationship between light intensity and the rate of photosynthesis.

Question 28 (3 marks)

Below is a diagram showing the process of pinocytosis.



Is pinocytosis a form of endocytosis or exocytosis? Explain your answer with reference to the diagram above. **3**

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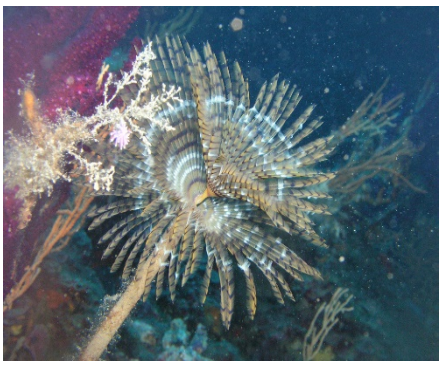
Question 29 (6 marks)

Student Number _____

The European Fan Worm (*Sabella spallanzanii)* is a filter feeding tube worm native to parts of the Atlantic Ocean and Mediterranean Sea. They have now spread to other parts of the world and are currently included on the Global Invasive Species Database. The European Fan Worm was first discovered by the CSIRO in NSW in 1996 and are considered a major threat to native Australian habitats and species.



Features: Grows in dense colonies; no known predators; consumes vast amounts of plankton to the detriment of native species; spiralled fan for feeding

Habitat: Anchors itself to hard surfaces, such as rocks or artificial structures; generally grows in shallow waters

A group of Biology students wanted to investigate the abundance of the European Fan Worm, however the worms often grow in clumps making it difficult to count individuals with accuracy. Instead, they decided to use the percentage cover method by making a quadrat with a 100-point grid. They randomly placed the grid at ten places on the rock platform and recorded the following results:

Quadrat	**Percentage cover (% European Fan Worm)**
1	52
2	60
3	64
4	48
5	53
6	57
7	44
8	54
9	50
10	58

(a) Calculate the average percentage cover of European Fan worm using the results in the table above. **1**

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Question 29 continues on the next page

Question 29 (continued)

(b) Justify the students' use of the percentage cover method to estimate the abundance of the abundance of the European Fan Worm instead of other methods. **3**

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(c) Why would it be beneficial for these students to monitor the abundance of the European Fan Worm for a number of years? **2**

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Student Number _____

Question 30 (4 marks)

The diagrams below show geological sections from two nearby excavations, and some of the fossil species discovered.

The volcanic ash deposits are the same age and come from the same eruption.

(a) List the fossil species in order from oldest to youngest. **1**

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(b) Describe how scientists can determine the age of the volcanic ash through radiometric dating. **3**

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Question 31 (3 marks)

Read the statement below.

Structure in Biology is influenced greatly by the need to maximise the surface area to volume ratio.

Explain why the ratio between surface area and volume (SA:V) is so important and discuss this importance using one named example at the cellular level. **3**

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End of Paper

Question 26-31 Extra writing space.

If you use this space clearly indicate which questions you are answering.

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2020 Task 3 Biology Preliminary Examination.
Marking Guidelines and Suggested Answers.
Part A Multiple Choice

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

Part B
Mrs Molino
Question 21 (a) (3 marks)

Marking Criteria	Marks
• A description including THREE of the following: • guard cells • take in water • by osmosis • (guard cells) become turgid/change shape/swell	**3**
• A description including TWO of the following: • guard cells • take in water • by osmosis • (guard cells) become turgid/change shape/swell	**2**
• Identifying the stomata or one correct statement describing how they work	**1**
• Non-attempt OR frivolous material OR objectionable material OR incorrect	**0**

Sample Answer

The **stomata** control gas exchange in the leaf. Each stoma **can** be **open** or closed, depending on how turgid its guard cells **are**. In the light, the guard cells absorb water by osmosis , become turgid and the stoma **opens**. In the dark, the guard cells lose water, become flaccid and the stoma closes.

Question 21 (b) (2 marks)

Marking Criteria	Marks
• An explanation linking these two of the following points: • No stomata (in the upper surface) to reduce water loss • Water loss during transpiration/evaporation AND • Stomata (on the lower surface) allow gas exchange • Gas exchange is needed for photosynthesis	**2**
• An explanation linking ONE of the two of the following points: • No stomata (in the upper surface) to reduce water loss • Water loss during transpiration/evaporation OR • Stomata (on the lower surface) allow gas exchange	**1**

• Gas exchange is needed for photosynthesis	
• Non-attempt OR frivolous material OR objectionable material OR incorrect	**0**

Sample answer

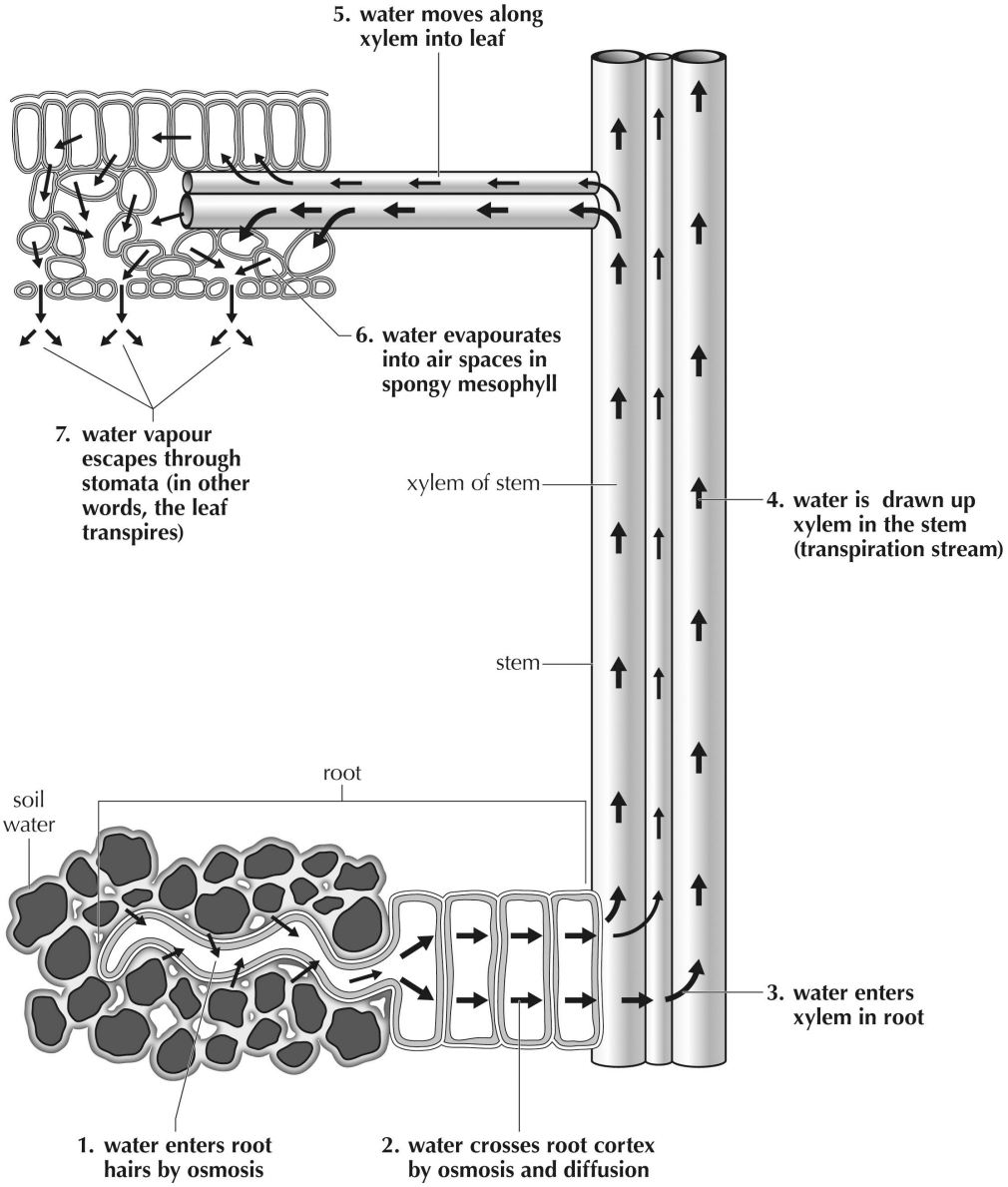
All surfaces of the leaf have some amount of stomata for regulating gas exchange for photosynthesis. However, the lower epidermis (the underside of the leaf) has more, because it is more often in the shade and so it is cooler, which means evaporation won't take place as much. This is to protect the plant from water loss. There they are well hidden from the sun in the shade of the leaf itself so the sun cannot evaporate the water that keeps the structure of the stomata proper. The upper part of leaf have fewer stomata because on the upper part they are more exposed to sunlight and wind.

Stomata allow carbon dioxide in, but they also let precious water escape. A plant that could get enough carbon dioxide with fewer stomata would have an advantage since it would be better able to conserve its water. On the other hand, when carbon dioxide levels are low, plants need many stomata in order to scrape together enough carbon dioxide to survive.

Question 22 (5 marks)

Marking Criteria	Marks
• All steps correct and thoroughly described to match steps on stimulus in question.	**5**
• At least 5 of the steps are correct and described to match steps on stimulus in question.	**4**
• 3-4 steps have been correctly labelled	**3**
• 2 steps have been correctly labelled	**2**
• One correct statement	**1**
• Non-attempt OR frivolous material OR objectionable material OR incorrect	**0**

Sample answer
On following page.



Question 23

(a)

Marking Criteria	Marks
• Thorough explanation linking of the following: • There is a variation in species/mutations cause variation • Different foods were available/there was competition for food • Finches with beaks better adapted for a food source lived/ finches without specially adapted beaks died • Those better adapted finches (survived to reproduce/ pass on their genes)	**3**
• Explanation linking two of the following: • There is a variation in species/mutations cause variation • Different foods were available/there was competition for food • Finches with beaks better adapted for a food source lived/ finches	**2**

without specially adapted beaks died • Those better adapted finches (survived to reproduce/ pass on their genes)	
• One correct statement	**1**
• Non-attempt OR frivolous material OR objectionable material OR incorrect	**0**

Sample answer

On the Galapagos Islands there is a variety of food sources. Originally, when the finches first arrived, there would have been competition for the same food. There is a variation in species due to mutations which would have resulted in some finches having beaks that enabled them to eat other foods. This would have reduced competition for the food source. These finches would therefore have flourished and reproduced, passing the mutation through their genes onto the offspring. The offspring would also be able to eat the other food. The finches who did not have the mutation would not flourish and the numbers would reduce or even die out. Eventually through continual mutation, the finches developed different beaks.

Question 24 (a)

Marking Criteria	Marks
• Correct answer (83.6 +- 5 μm) must include units	**1**

Sample answer

11.7 x 10 / 1.4 =
83.6 μm.

Question 24 (b)

Marking Criteria	Marks
• Discussion covering: - Advantage of being unicellular - Disadvantage of being unicellular - Advantage of being multicellular - Disadvantage of being multicellular	**4**
• 1-3 of the above	**1-3**

Sample answer

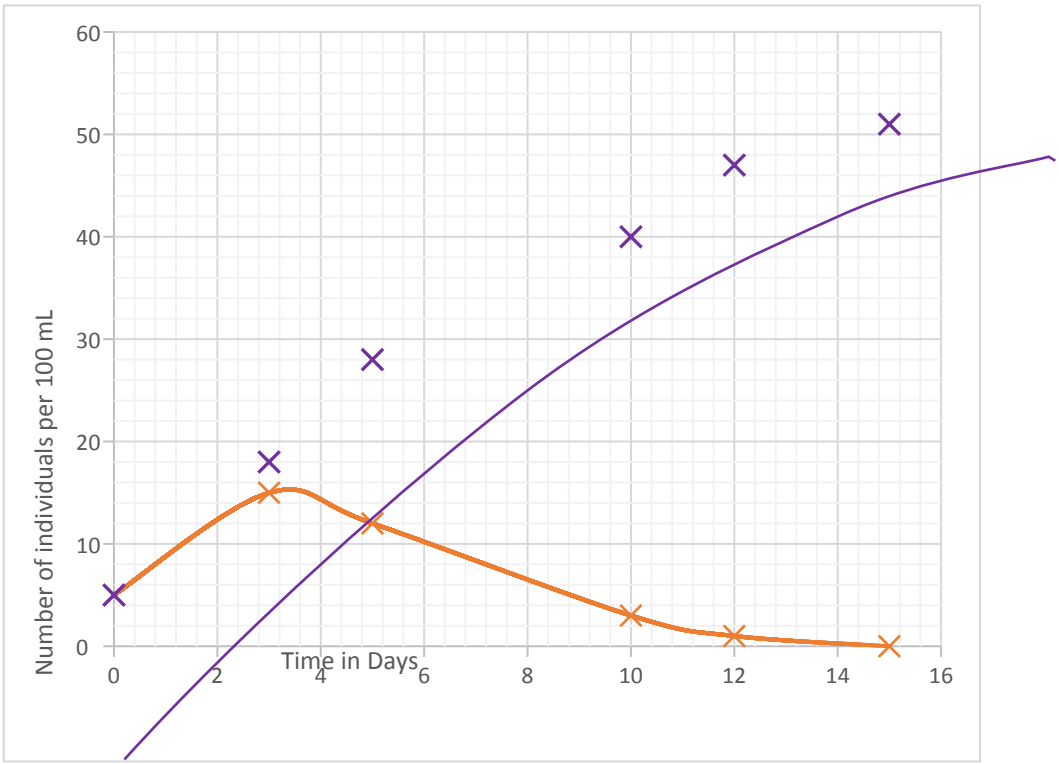
Unicellular organisms have the advantage of not being dependent on other cells for their need, they can carry out all the requirements of life by themselves. This means, however, that they have to be generalists – performing all of the functions necessary for life. This puts an upper limit on size (due to SA:V ratio) and on complexity.
Multicellular organisms can grow much larger than unicellular organisms and can be much more complex-having tissues of cells specialised for particular roles. However, the disadvantage of this is that with specialisation of cells comes interdependence. If a particular type of cells malfunctions or dies, then so does the whole organism.

Question 24 (c)

Marking Criteria	Mark

• Both axes labelled with units • Points plotted correctly • Lines of best fit drawn • 80% of space used	**3**
• Partially complete graph	**2**
• Identifies an aspect of the graph	**1**

Sample answer



Question 24 (d)

Marking Criteria	Marks
• Relationship identified as competition • Causative links made between variations in one population and the other • Refers to graph	**3**
• Relationship identified as competition and changes in populations described OR • Changes in populations described and refers to the graph	**2**
• Relationship identified as competition OR • Changes in population described	**1**

Sample answer

The relationship is competition. The populations of both increase for the first three days, but then as *P.aurelia* increases and exploits resources more successfully than *P. caudatum, P caudatum* dies out by day 15 and *P aurelia'*s numbers increase to 51 per 100mL.

Question 25

Marking Criteria	Marks
• Thoroughly explains how both structures are adapted to absorb molecules	**4**
• Explains some features of both structures	**3**
• Briefly describes the features of one structure	**2**
• One correct statement	**1**

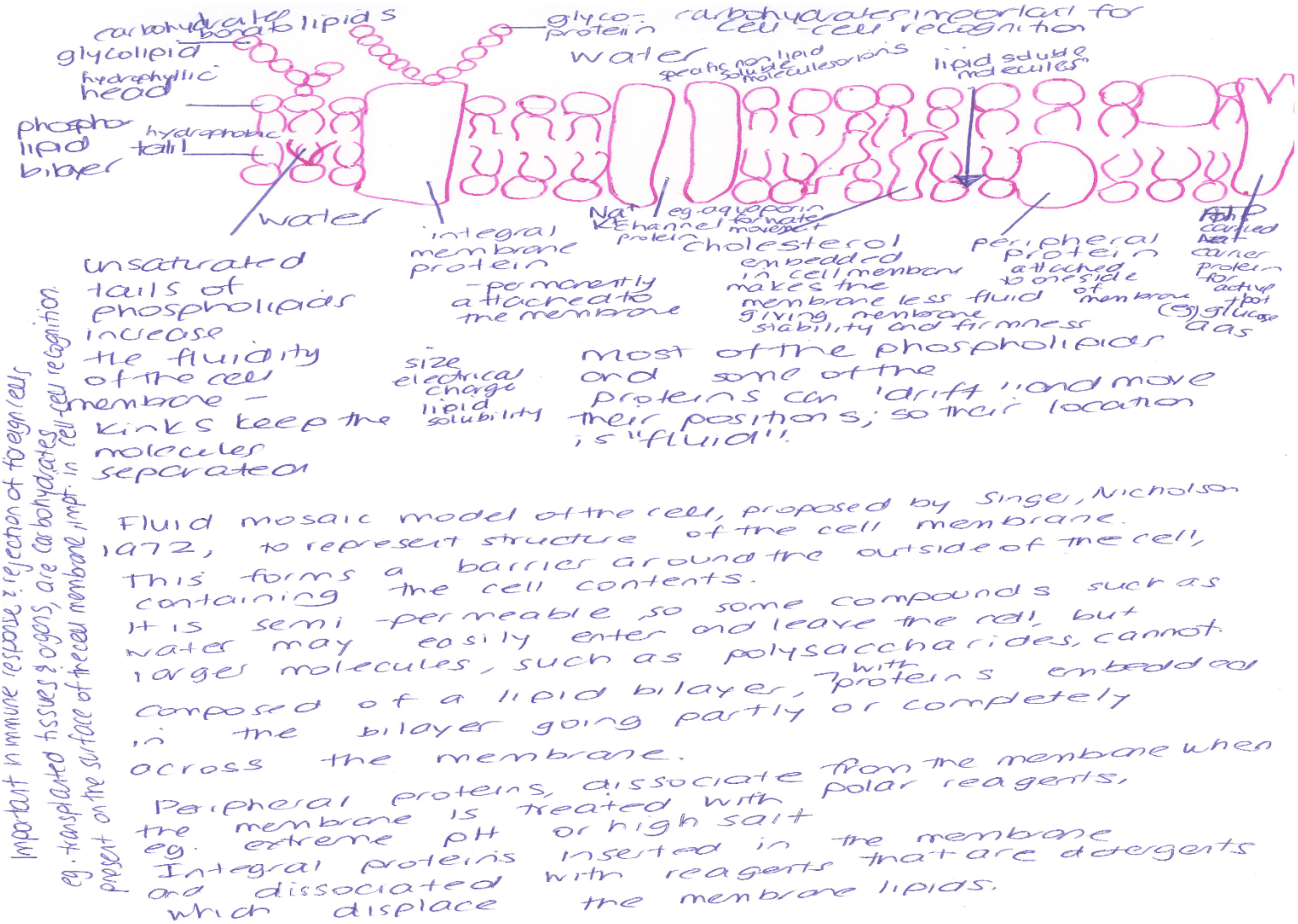
Sample Answer:

Microvilli increase the surface area to increase the ability to absorb the products of digestion eg sugars, amino acids. Alveoli increase the surface area to increase gaseous exchange. Both structures are only one cell thick so that diffusion occurs quickly. The large blood supply of the microvilli and alveoli , which reaches each cell through capillaries, facilitates removal of the diffused chemicals and thereby maintains the concentration gradient. The moist surfaces of the alveoli also facilitate dissolution of oxygen and removal of carbon dioxide.

Part C
Mrs Zois
Question 26
(a)

Marking Criteria	Marks
• Clearly and thoroughly completes, with labels and annotates with extra information and notes. • Clear outlines and correct labelling	**4**
• Clearly draws and labels with at least four labels.	**3**
• Drawn with labels	**2**
• Minimal drawn	**1**

Sample answer



(b)

Marking Criteria	Marks
• Describes the features of the fluid mosaic model • Relates features to movement of multiple substances into and out of the cell	**3**
• Describes the features of the fluid mosaic model, but may not link these features to the movement of substances into and out of the cell	**2**
• One correct statement, identifies one feature of the fluid mosaic model of the cell	**1**

Sample answer

The fluid mosaic model of the cell membrane shows that the cell membrane is composed of a phospholipid bilayer and other molecules, such as proteins distributed across the membrane in a 'mosaic' pattern. Lipid-soluble molecules, such as Oxygen and Carbon Dioxide, are able to diffuse across the membrane. Larger molecules such as amino acids and glucose need to be actively transported across the membrane by proteins in facilitated diffusion. Integral proteins span the width of the membrane, whereas peripheral proteins are on the surface.

Question 27
(a)

Marking Criteria	Marks
• Correctly names the organelle	**1**

Sample Answer
Chloroplast
(b)

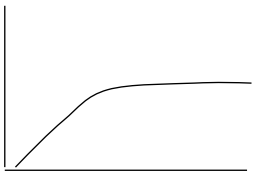
Marking Criteria	Marks
• All four substances correct	**2**
• 3 correct	**1**

Sample Answer
Water + Carbon dioxide → glucose + oxygen

(c)

Marking Criteria	Marks
• Correct curve	**1**

Sample Answer



• Correctly identifies pinocytosis as a form of endocytosis as the cell is taking in materials from the extracellular fluid • May not clearly link answer to the diagram	**2**
• Correctly identifies pinocytosis as a form of endocytosis	**1**

Sample Answer
Pinocytosis is a form of endocytosis because it involves the cell taking in fluid matter or 'drinking'. In the diagram the substances in the extracellular fluid are taken into the cell in a small vesicle. Exocytosis is the process where a cell removes wastes/toxins to outside the cell.
Question 29
(a)

Marking Criteria	Marks
• Correctly identifies 54% coverage	**1**

Sample Answer

54% coverage by the European Fan Worm (Add all results, then divide by 10)

(b)

Marking Criteria	Marks
• Provides reasons as to why this method is more suitable than other methods, such as capture-recapture and traditional quadrat method. • Provides appropriate justification for reasons using evidence	**3**
• Provides a suitable reason for why the percentage cover method is suitable for this organism • May not compare this method to other sampling methods	**2**
• Provides some relevant information about the percentage cover sampling method OR • another sampling method	**1**

Sample Answer

The European fan worm often grows in clumps, so using quadrat sampling would be difficult to do with any accuracy as it would be hard to distinguish individuals.
Capture-recapture would also not be appropriate as they anchor themselves to rocks, so do not move. Percentage cover method enables them to determine the percentage cover in different zones.

(c)

Marking Criteria	Marks
• Demonstrates the link between continuing to measure the abundance of the European Fan Worm over time and a suitable benefit to society or the environment.	**2**
• Suitable reason given for continuing to monitor abundance of the European Fan Worm • May not link cause and effect	**1**

Sample Answer

It is very important to continue to monitor the abundance of the European Fan Population in order to see if the abundance is increasing, decreasing or remaining the same. This will enable scientists to determine the impact on other native species and implement strategies to reduce the population if required.

Question 30

(a)

Marking Criteria	Marks
• Correct sequence	**1**

Sample Answer

Sea urchin, brachiopod, star fish, limpet.

(b)

Marking Criteria	Marks
• Explains incorporating the following; • Description of properties of a radioactive isotope • Explanation of half life	**3**

• Link made between quantity of isotope present, half-life and age of rock.	
• 1-2 of the above	**1-2**

Feedback #11 referred to reference radioactive isotope **#16**
The technique of **comparing the abundance ratio of a radioactive isotope to a reference isotope** to determine the age of a material is called radioactive dating..
log F = (N/H)log(1/2) where: F = fraction remaining N = number of years and H = half life.
To determine the fraction still remaining, we must know both the amount now present and also the amount present when the mineral was formed.

Sample Answer
There are several radioactive isotopes that are found in rocks. They decay at a constant and measurable rate. The rate of decay is expressed in half-lives – one half-life is the time it takes for half of any given amount of the isotope to decay.
Radiometric dating works by measuring the concentration of a radioactive isotope present in the rock. If the concentration of the isotope in freshly formed volcanic ash is known then an age can be determined in half-lives. The comparison of the abundance ratio of a radioactive isotope to a reference isotope determines the age of the material.

Question 31

Marking Criteria	Marks
• Correctly outlines Surface Area: Volume ratio • Wastes and nutrients must be adequately transported into and out of the cell. • Explains relationship between surface area and rate of transfer • Explains relationship between Volume and cell requirements • Names and discusses example at cellular level	**3**
• One of the above is missing or unclear or not completely correct and thorough	**2**
• Provides minimal information	**1**

Sample Answer
The ratio of surface area to volume is of central importance in Biology and is a major influence on the size and shape of cells, organs and organisms. This ratio must be adequate in order to transport nutrients and waste products of metabolism into and out of the cell at an efficient rate.
The surface area of a cell, or other structure is directly proportional to the rate at which materials can be taken up or moved out of it, if such movement is to occur across the surface.
The volume of a cell is directly proportional to the metabolic requirements of that cell. If its volume doubles it will need double the amount of oxygen.
This relationship puts an upper limit on the size of cells, because as a cell grows in size its surface area grows by a square function, but its volume grows by a cube function. Meaning that the larger it is, the less able it is to exchange enough materials to support its metabolism.
Unicellular organisms like Paramecium can only grow to a length of a few hundred micrometres. Any larger and they could not support themselves.