



Student number: _____

**PENRITH
SELECTIVE HIGH
SCHOOL
2020
BIOLOGY
PRELIMINARY
YEARLY EXAMINATION**

General Instructions

- Reading time – 5 minutes
- Exam time – 2 hrs
- Board-approved calculators may be used
- Write using **blue or black** pen
- Answers written in pencil may be disqualified from review

PART A - *Multiple Choice* (15)

- Attempt Questions 1 – 15
- Allow about 30 minutes for this part
- Use the multiple choice answer sheet found at the end of this paper
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PART B - *Free Response Questions* (60)

- Attempt Questions 16 – 28

TOTAL MARKS

/75

THIS EXAM PAPER MUST BE SUBMITTED AT THE END OF THE EXAMINATION

PART A – MULTIPLE CHOICE QUESTIONS

Attempt Questions 1-15

Allow about 30 minutes for this part

Use the multiple-choice answer sheet for questions 1-15

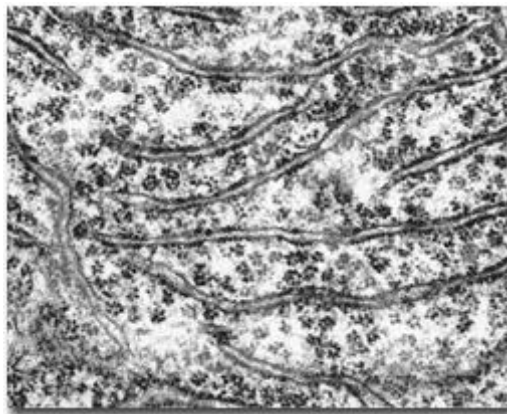
Question 1

Photosynthesis:

- (A) Occurs in heterotrophs
- (B) Requires glucose and oxygen
- (C) Converts light energy into chemical energy
- (D) Does not require enzymes

Question 2

The electron photomicrograph below shows a network of membranes within a cell.

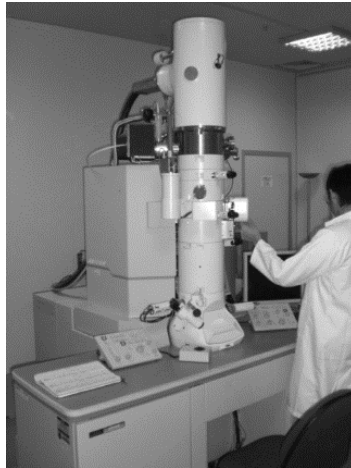


Which one of the following is the correct name for these membranes?

- (A) Cell membrane
- (B) Golgi body
- (C) Endoplasmic reticulum
- (D) Nuclear membrane

Question 3

The piece of technology shown below is an electron microscope, it has had a major impact on our understanding of cell biology.

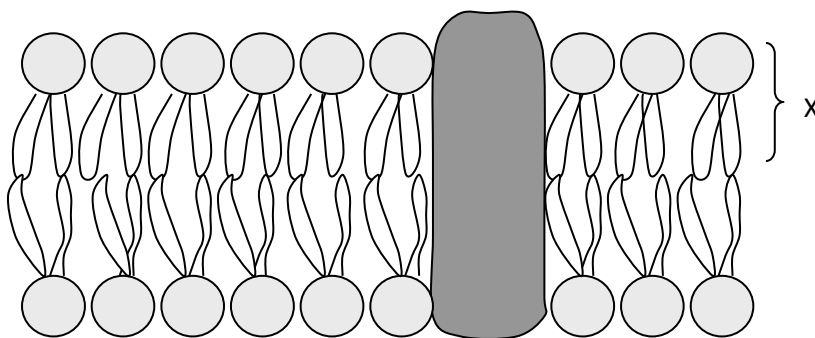


One of its important contributions to that understanding has been:

- (A) Viewing the nucleus for the first time
- (B) Viewing ribosomes for the first time
- (C) Viewing the cell wall for the first time
- (D) Viewing chloroplasts for the first time

Question 4

The diagram below illustrates the structure of a cell membrane.



The molecule indicated by X is a:

- (A) Carbohydrate
- (B) Phospholipid
- (C) Nucleic acid
- (D) Protein

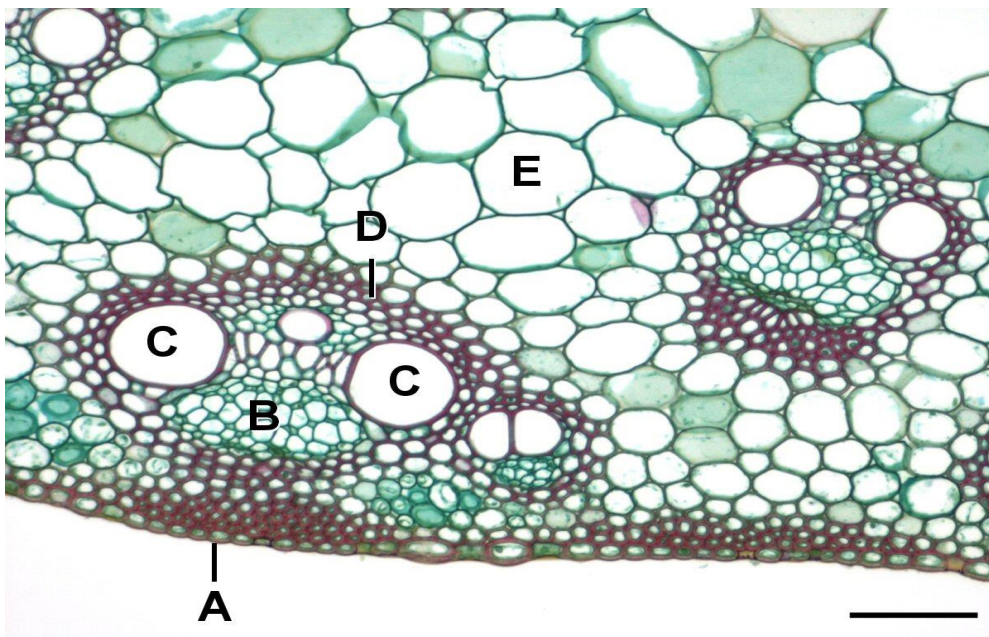
Question 5

Which of the following is a correct description of the organisation of structures in plants.

	Organism	System	Organ	Tissue	Cell
A	Shoot	Leaf	Mesophyll cell	Spongy mesophyll	Rose plant
B	Rose plant	Shoot	Leaf	Spongy mesophyll	Mesophyll cell
C	Rose plant	Leaf	Shoot	Spongy mesophyll	Mesophyll cell
D	Rose plant	Spongy mesophyll	Leaf	Shoot	Mesophyll cell

Question 6

Consider the image of a plant stem below.

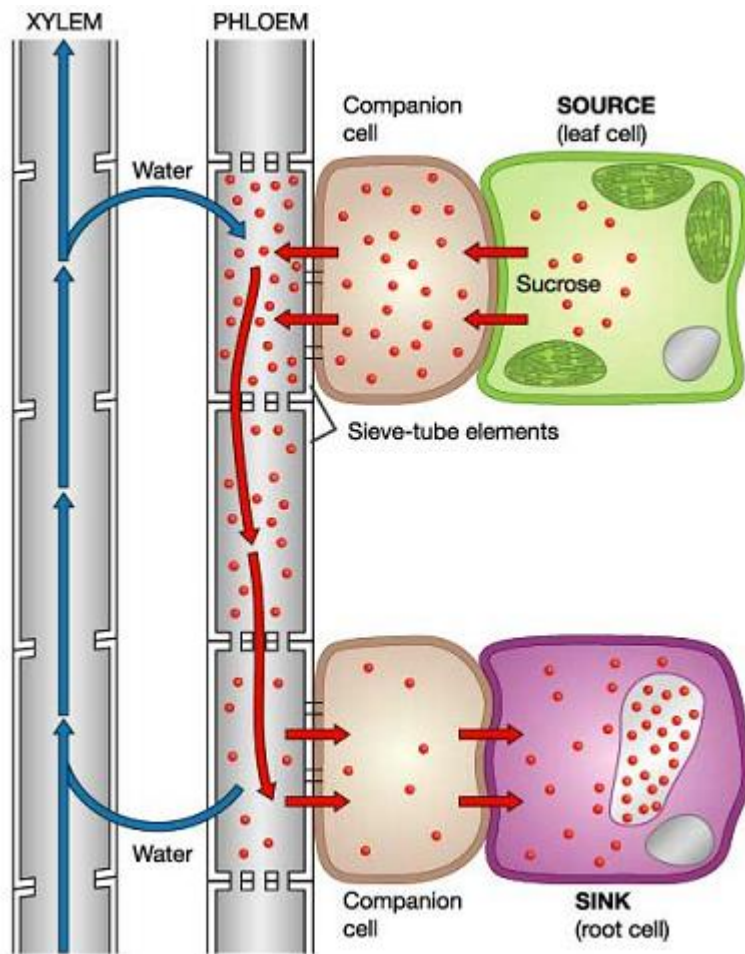


The structures C in the image show

- (A) Parenchyma
- (B) Phloem
- (C) Epidermis
- (D) Xylem

Question 7

The diagram shows a process in plants.



A correct name for the process shown is:

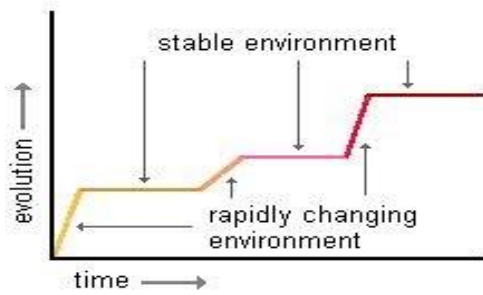
- (A) The transpiration-cohesion-tension model
- (B) Osmosis in root hair cells
- (C) Translocation of sugars by the pressure flow model
- (D) Absorption of glucose in the duodenum

Question 8

Antibiotic resistant strains of bacteria have arisen because:

- (A) Bacteria are not harmed by artificial chemicals such as penicillin
- (B) The human immune system has evolved to neutralise harmful bacteria
- (C) Individual bacteria with resistance to antibiotics are naturally selected
- (D) Scientists have genetically modified bacteria and these have escaped

Question 9

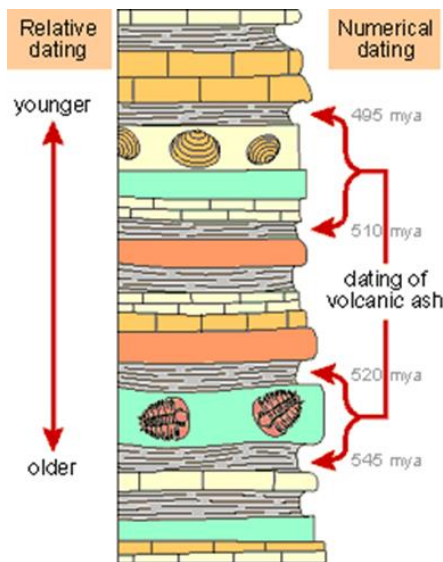


The image above represents which of the following processes:

- (A) Punctuated equilibrium
- (B) Gradualism
- (C) Allopatric speciation
- (D) Divergent evolution

Question 10

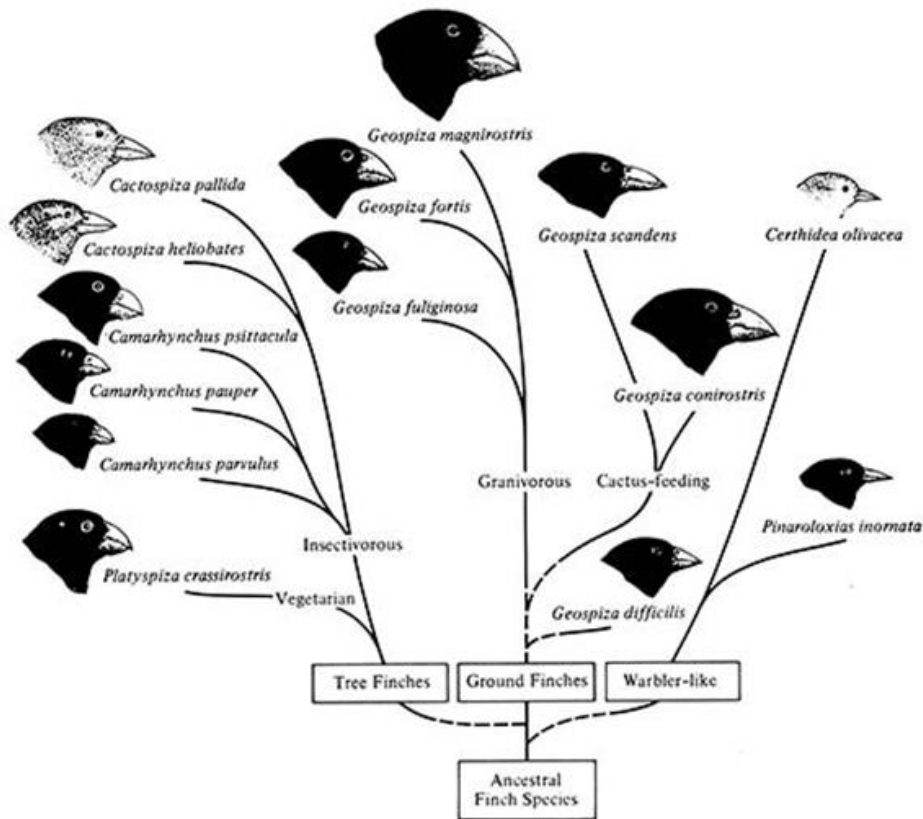
Consider the diagram of rock strata below.



Radiometric dating using information on the amounts of decaying isotopes can be used to:

- (A) Give the relative age of fossils
- (B) Indicate the absolute numerical age of igneous rocks
- (C) Show which sedimentary layers were laid down first
- (D) Give absolute numerical dates of sedimentary rocks

Question 11



The diagram shows the probable evolutionary relationships of finches in the Galapagos islands.

Charles Darwin used his own observations of these finches and other data collected during the voyage of HMS Beagle to conclude that;

- (A) All species must have been specially created by God
- (B) Interaction between inheritable variation, survival, reproductive success and environmental variation can lead to changes in species
- (C) Successful parents pass on their acquired characteristics to their offspring
- (D) The birds on the Galapagos islands had different ancestors to birds in South America

Question 12

'Nectar feeders', such as marsupial honey possums, have a relatively simple digestive tract, compared with herbivores and carnivores.



Why do nectar feeders have a relatively simple digestive tract?

- (A) Nectar feeders are much smaller than other mammals and thus do not need complex digestive tracts.
- (B) Nectar feeders are nocturnal, spending most of the time sleeping; and thus do not need the extra energy from a complex digestive tract.
- (C) Nectar is mostly glucose sugar and thus is easily absorbed by the digestive tract.
- (D) Nectar is relatively poor in nutrients and thus passes through the digestive tract, for excretion, unchanged.

Question 13

Gas analysis of ice cores in Antarctica has shown which trend over the last 100 years?

- (A) Atmospheric concentration of greenhouse gases have increased
- (B) There has been no change in atmospheric concentrations of greenhouse gases
- (C) Atmospheric concentration of greenhouse gases have decreased
- (D) Global temperatures have decreased

Question 14



source : <https://sharktours-hawaii.com/blog/shark-remora-fish-unique-relationship/>

The picture above shows a shark with remora fish.

This is an example which type of species interaction:

- (A) Parasitism
- (B) Commensalism
- (C) Predation
- (D) Competition

Question 15

The following diagram shows *Chaesipho columna*, the honeycomb barnacle



Source: <https://collections.museumsvictoria.com.au/species/8622>

This organism is a small greyish barnacle, which has four plates. It often occurs in such numbers that the plates become hard to identify for any one individual. What would be the best way to determine the abundance of this barnacle?

- (A) Percentage cover
- (B) Capture- mark- recapture
- (C) Tagging individuals and following their movement
- (D) Count all individuals

PART B – FREE RESPONSE QUESTIONS

Attempt Questions 16 – 28

Allow 1.5 hours for PART B

Question 16 (4 marks)

Four students were asked to design a first-hand investigation to determine the effect of pH on the activity of the enzyme. Their designs of the investigation are shown in the tables below.

Design A

<i>Tube number</i>	<i>Contents</i>	<i>pH</i>	<i>Temp. (°C)</i>
1	E	3	20
2	E	7	20
3	E	12	20
4	S	3	20
5	S	7	20
6	S	12	20

Design B

<i>Tube number</i>	<i>Contents</i>	<i>pH</i>	<i>Temp. (°C)</i>
1	E + S	3	20
2	E + S	7	20
3	E + S	12	20
4	S	3	20
5	S	7	20
6	S	12	20

Design C

<i>Tube number</i>	<i>Contents</i>	<i>pH</i>	<i>Temp. (°C)</i>
1	E + S	3	10
2	E + S	7	20
3	E + S	12	30
4	S	3	10
5	S	7	20
6	S	12	30

Design D

<i>Tube number</i>	<i>Contents</i>	<i>pH</i>	<i>Temp. (°C)</i>
1	E + S	7	10
2	E + S	7	20
3	E + S	7	30
4	S	7	10
5	S	7	20
6	S	7	30

Key: E = enzyme S = substrate

- a) State which of the designs A-D is the most appropriate. (1 mark)

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b) For each of the other three designs, outline ONE reason as to why each design is unsuitable. (3 marks)

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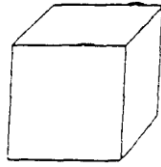
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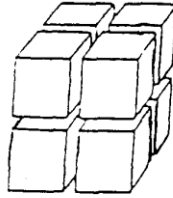
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Question 17 (5 marks)

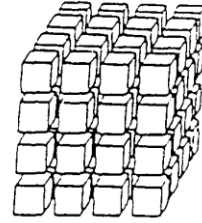
Refer to the diagram below in which the cubes represent typical living cells. Cell A, Tissue B, and Tissue C all have the same volume.



Cell A



Tissue B



Tissue C

- a) What changes would occur in the size of these cells when they are placed in **distilled** water? Explain your answer. (2 marks)

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- b) Would you expect the change to occur at the same rate in all three samples? Explain your answer. (3 marks)

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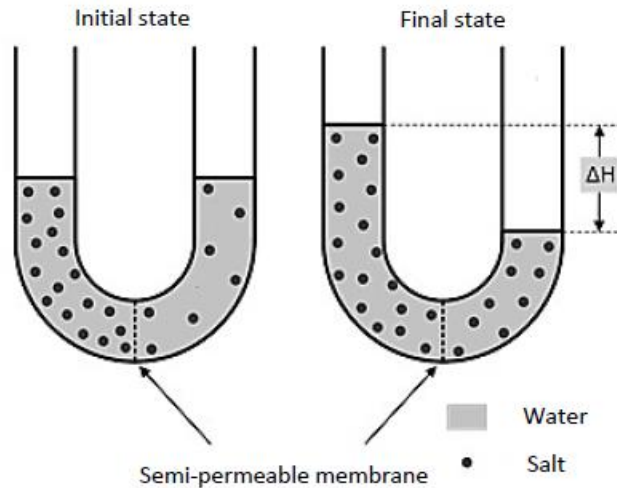
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Question 18 (6 marks)

The diagram below is a model of some important biological processes. The selectively permeable membrane is permeable to both salt and water.



a) Explain what happened to the salt ions and state the process involved. (2 marks)

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b) Identify what happened to the water molecules and explain the process involved. (3 marks)

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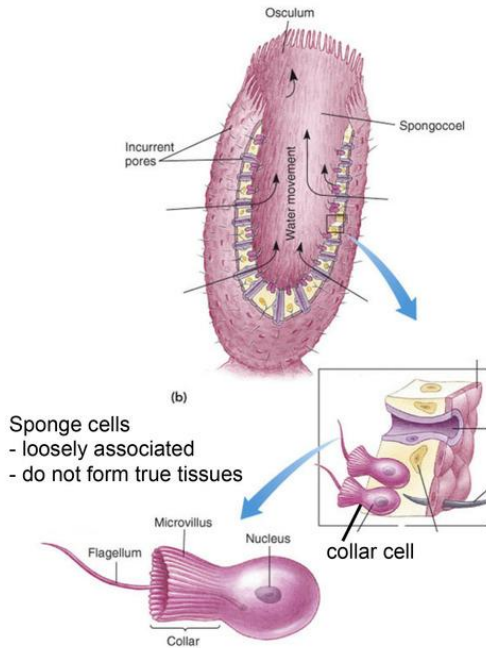
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c) Identify which of the 2 processes, that you suggested above, results in the change of water levels shown in the diagram above. (1 mark)

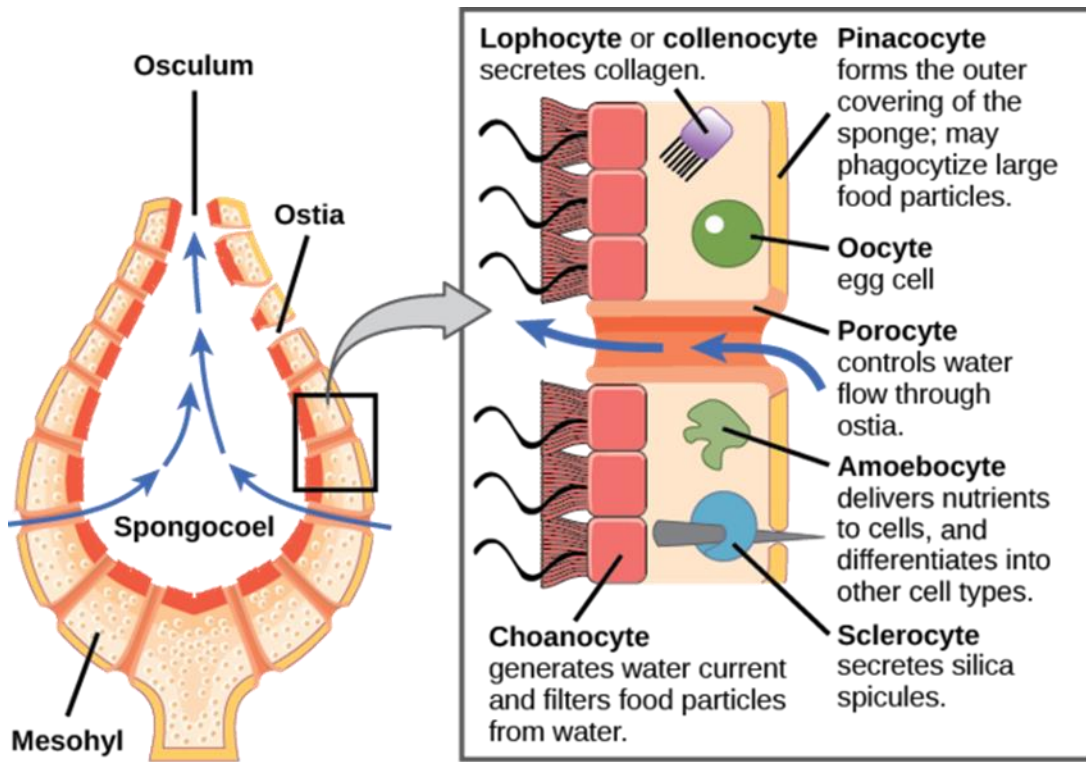
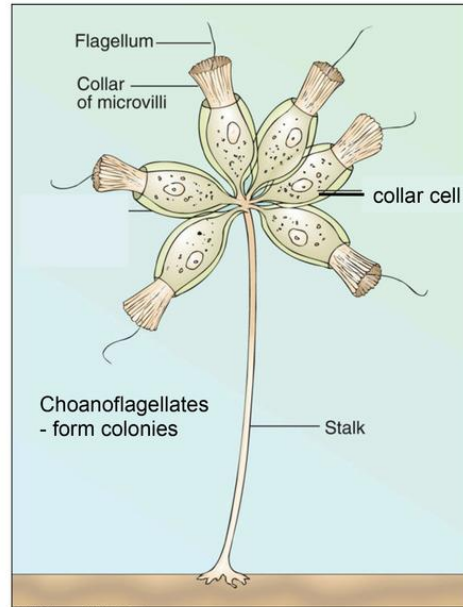
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Question 19 (4 marks)

Sponges



Choanoflagellates



(a) Basic sponge body plan

(b) Some sponge cell types

Question 19 continued (4 marks)

Consider the diagrams on the previous page which show information about the organisation of cells in sponges and choanoflagellates.

Sponges (simple animals from the phylum Porifera) are considered to be the most basic form of multicellular animal. Some of their cells are very similar to the group of protists called choanoflagellates.

- a) Give reasons why collar cells and choanoflagellates are both eukaryotic cells. (1 mark)

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- b) Explain why sponges are generally considered to be multicellular organisms whilst choanoflagellates are considered to be colonial. (3 marks)

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Question 20 (4 marks)

Read the following paragraph, written by Jean Baptista Van Helmont and published in 1648.

“I took an earthen pot and in it placed 200 pounds of earth which had been dried out in an oven. This I moistened with rain water, and in it planted a shoot of willow which weighed five pounds. When five years had passed the tree which grew from it weighed 169 pounds and about three ounces. The earthen pot was wetted whenever it was necessary with rain or distilled water only. It was very large, and was sunk in the ground, and had a tin plated iron lid with many holes punched in it, which covered the edge of the pot to keep air-borne dust from mixing with the earth. I did not keep track of the weight of the leaves which fell in each of the four autumns. Finally, I dried out the earth in the pot once more, and found the same 200 pounds, less about 2 ounces. Thus, 164 pounds of wood, bark, and roots had arisen from water alone.”

- a) Identify the dependent variable in this experiment. (1 mark)

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- b) Explain why Van Helmont was incorrect in suggesting that the increase in mass of the willow tree “had arisen from water alone.” (3 marks)

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Question 21 (6 marks)

“Big, complicated animals like camels and humans need a closed circulatory system whilst small animals like bees and snails don’t.”

Justify this statement with reference to the movement of particles such as nutrients and waste products. (6 marks)

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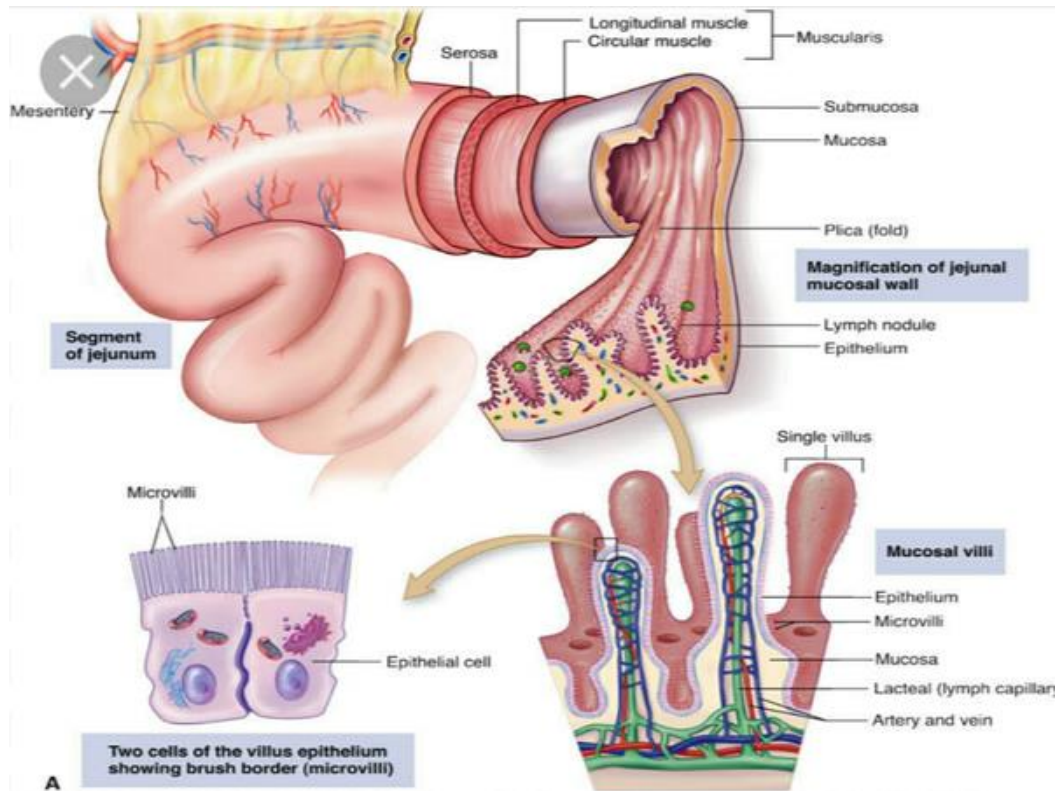
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Question 22 (3 marks)

The diagram below shows the structure of the first part of the small intestine of humans.



Explain how one feature helps ensure that the products of digestion are efficiently absorbed.

(3 marks)

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Question 23 (7 marks)

Read the following extract from Australia, State of the Environment 2016, a Federal Government publication.

There are concerns globally that many pollinators are in decline, in response to pressures such as habitat loss, disease, impact of invasive species and climate change. Like many countries, Australia does not have sufficient historical records of bee distribution or abundance to detect whether native bee species are in decline. Data are available, however, to indicate that the drivers of pollinator decline indicated in other studies are also present in our landscapes.

Loss of bees from landscapes is of concern because of the expected flow-on effects on pollination outcomes. Studies in Australia show changes in pollination rates of native plants that are associated with fragmentation of habitat and impacts of invasive species. Pollination of agricultural crops is mostly done by wild pollinators and so is similarly dependent on landscape context; however, agricultural pollination is sometimes supplemented with managed honeybees.

Australia's population of western honeybees (both managed and feral) is one of the last globally to be free from the devastating varroa mite (*Varroa destructor*). This mite and its associated disease complex have had dramatic effects on honeybees elsewhere in the world, including nearby New Zealand, where it arrived in 2001. It is thought that varroa will eventually establish in Australia. It is expected to dramatically reduce the abundance of feral honeybees and cause economic challenges for beekeepers that will, at least in the short term, reduce availability of hives for crop pollination. Native bees are immune to the disease, and may even increase in abundance in places where they have competed with feral bees.

<https://soe.environment.gov.au/>

Question 24 (3 marks)

Consider the pictures of an echidna, a hedgehog and a porcupine shown respectively below.



These animals are from different orders of mammals and live in widely separated habitats. Account for the similarity in appearance of these species. (3 marks)

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Question 25 (3 marks)

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Human Cytochrome C Oxidase subunit 6B: TGTCAGAAGGCAATGACCGCTAA
Plant Cytochrome C Oxidase subunit 6B:  TATCACAGATGTGTAGCTGCTAA

AGGAGGCGATATCTCTGTTGCGAATGGTACCAGCGTGTGTACCAGTCCCT
GGGTGATGATGTCTCCAGAATGCGATAAGTTTGCAAAGTTTTATCGATCTCT

CTGCCCCACATCCTGGGTCACAGACTTGGGATGAGCAACGGGCTGAAGGCCAC
TTGCCCCAGCGAATGGGTTGATAGTGGAACGAGCAAAGAGAAAATGGAAC

GTTTCCCGGGAAGAT
ATTCCCTGGTCCTCT
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The diagram above shows the DNA base sequence which codes for the human cytochrome c oxidase enzyme compared with a plant cytochrome c oxidase enzyme. Cytochrome c oxidase is a vital protein associated with respiration in almost all life forms.

Explain why this information provides evidence to support the theory of evolution by natural selection. (3 marks)

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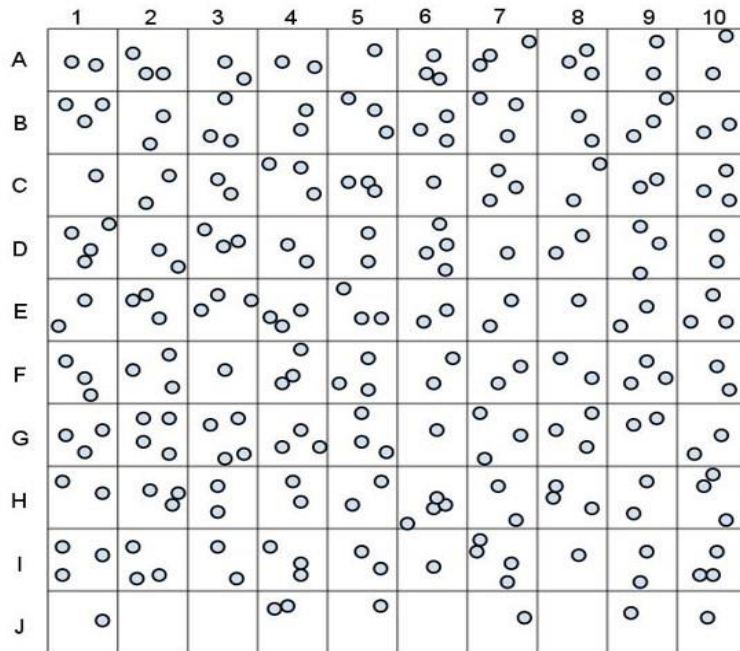
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Question 26 (4 marks)

The grid shown below represents a meadow measuring 10 m on each side. Each grid segment is 1 m x 1 m. Each black circle represents one sunflower plant.



a) Complete the table below

(2marks)

Quadrat	Number of sunflower
A9	
D4	
I6	
J10	
H2	
E8	
G5	
C7	
B3	
F10	
Total	

Question 26 continued (4 marks)

b) Calculate the abundance of sunflowers using the formula below. (2 marks)

Abundance = total number of individuals / (number of quadrats x area of each quadrat)

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Question 27 (3 marks)

Explain the impact of climate change on biodiversity of species on Earth. (3 marks)

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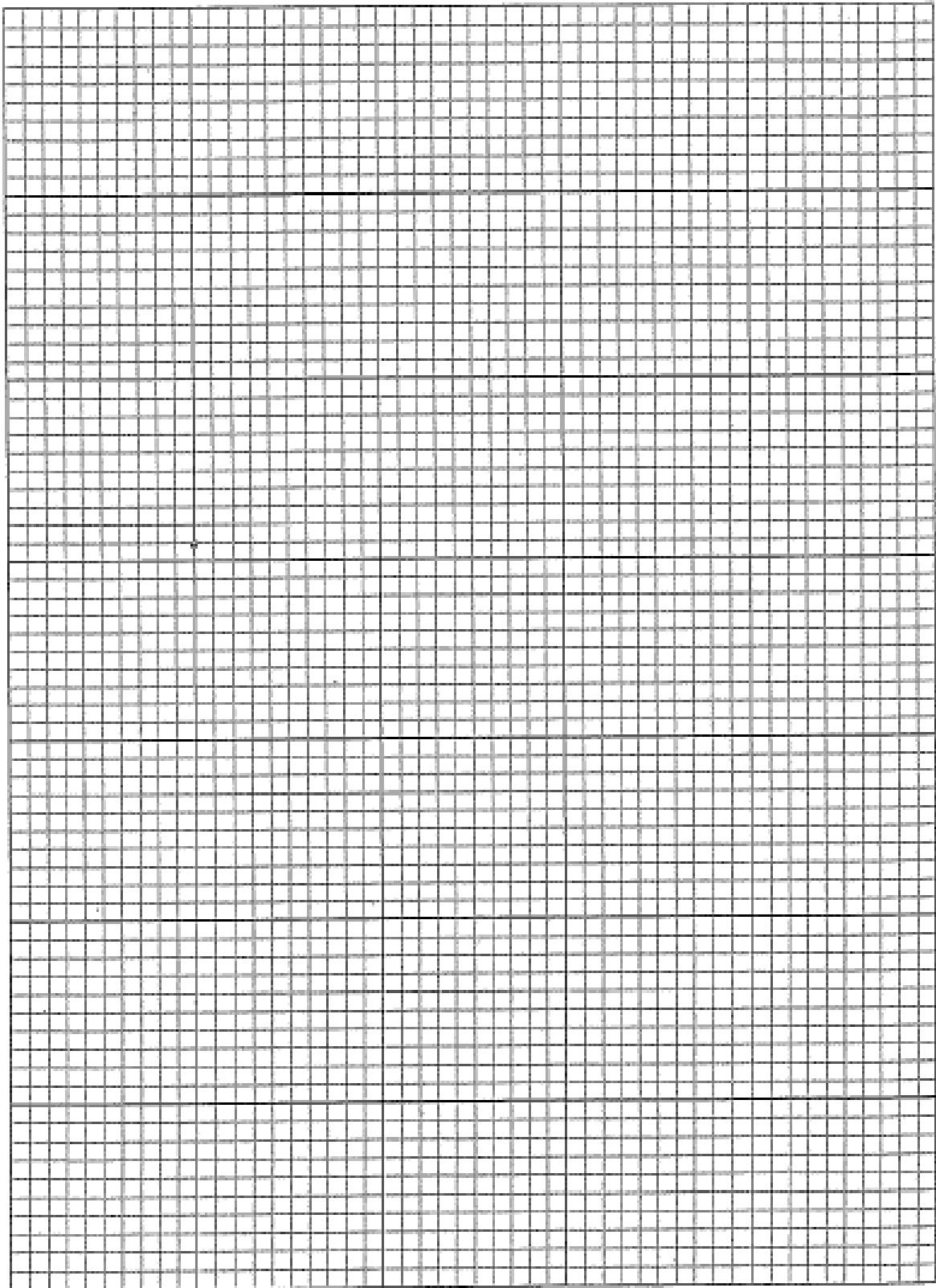
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Question 28 (8 marks)

Below is a table of the population of Reindeer on St Matthew Island after the US coast guard introduced 29 reindeer to the Island. The intention was to farm the reindeer for food. Reindeer are ruminants, having a four-chambered stomach. They mainly eat lichens in winter, especially reindeer moss. However, they also eat the leaves of willows and birches, as well as sedges and grasses.

Year	Population size
1944	29
1950	35
1957	1350
1960	2700
1963	6000
1964	3000
1966	42
1980	0

- a) Use the graph paper on the next page to construct a graph for the data given above.
(4 marks)



b) Provide a plausible reason for the decline of the population. (2 marks)

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c) Describe the trend in the data. (2 marks)

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-END OF EXAMINATION -

PART A – INSTRUCTIONS FOR MULTIPLE CHOICE QUESTIONS

Use the multiple-choice answer sheet provided to answer PART A.

Select the alternative A, B, C or D that best answers the question.

Fill in the response oval completely.

Example $2 + 4 = ?$

2	6	8	9
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

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

<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
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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:

<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
	correct ↓		

Student Number: _____

PART A – MCQ 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 ○