

Candidate Name	Centre Number				Candidate Number			
					0			

**AS BIOLOGY****UNIT 2****Biodiversity and Physiology of Body Systems****SPECIMEN PAPER****(1 hour 30 minutes)****80 marks**

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	11	
2.	14	
3.	11	
4.	11	
5.	16	
6.	8	
7.	9	
Total	80	

ADDITIONAL MATERIALS

In addition to this examination paper, you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question 7.

Answer **all** questions

1. Biological classification is based on the evolution of organisms from their most recent common ancestor. Consequently, the characteristics used in classification are homologous. However, it is often difficult to distinguish between homologous and analogous structures that have evolved through convergent evolution.

- (a) Explain the difference between **homologous** and **analogous** characteristics.

[2]

.....

.....

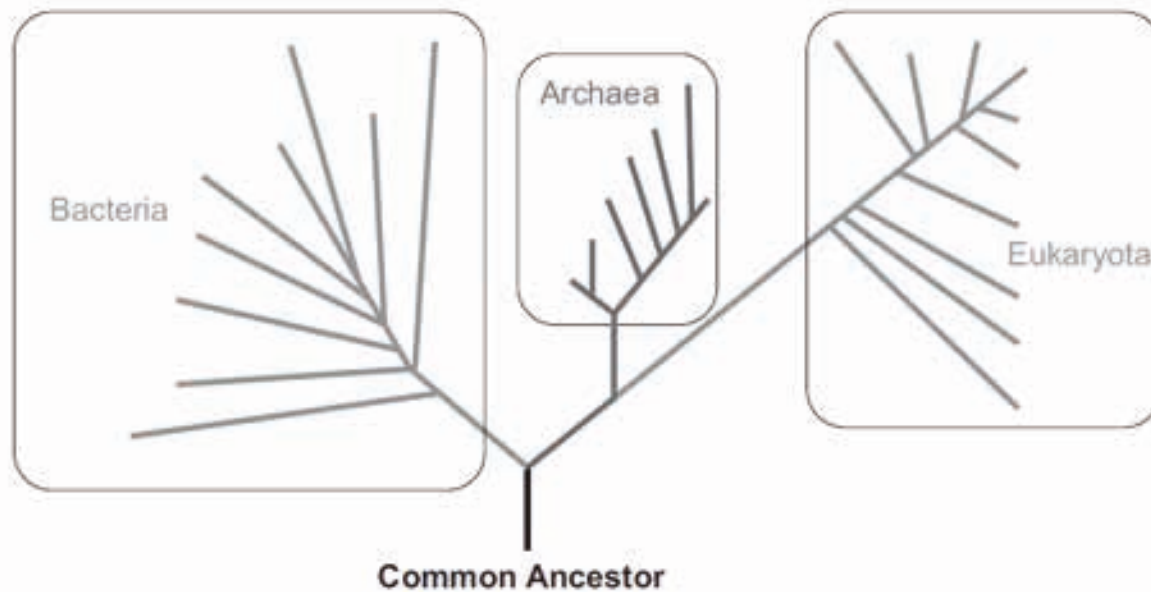
.....

- (b) Traditional classification systems grouped organisms into five kingdoms. Bacteria and Archaea were grouped into the kingdom Prokaryotae while the eukaryotes were grouped into four different kingdoms.

Complete the table below by giving the names of these kingdoms. [2]

		Kingdom			
	
Characteristic	main component of cell wall	none present	chitin	cellulose	cellulose if present
	chloroplast	x	x	✓	present in some species
	shows tissue differentiation	✓	✓	✓	x
	method of nutrition	heterotrophic	heterotrophic	autotrophic	some heterotrophic, some autotrophic

- (c) A more modern classification system proposes the evolutionary relationships between organisms as shown in the diagram below.



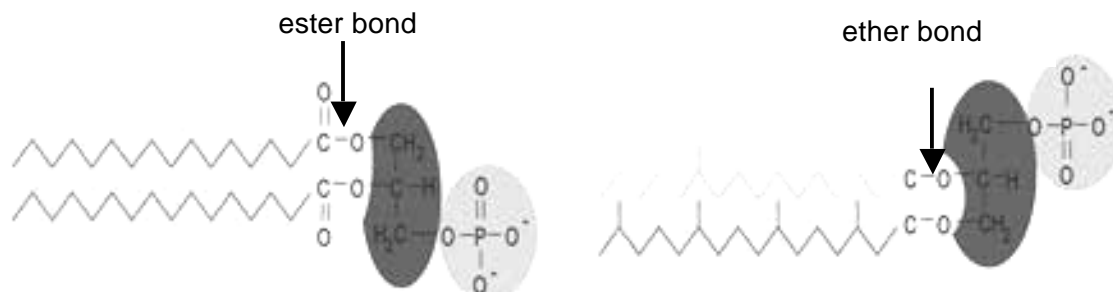
- (i) What is the name given to this type of diagram? [1]

- (ii) What name is given to this theory of classification? [1]

- (d) Classification of living organisms into bacteria, archaea and eukaryota has been largely based on analysis of the gene coding for a ribosomal subunit. Describe and explain how analysis of this gene can provide evidence for this modern theory of classification. [2]

.....

- (e) Many archaea are called 'extremophiles' and are found living in hot springs and water with very high or low pH. All living cells are surrounded by a cell membrane composed of phospholipids. The fatty acid and glycerol components of the phospholipid can be joined together by two different bonds as shown in the diagram below.



The ether bond is more resistant to hydrolysis in both acid and alkaline conditions than the ester bond and is also less reactive at high temperatures. Fatty acids found in phospholipids can be straight-chained or branched. Membranes containing branched phospholipid molecules are less fluid than those containing straight chain phospholipids and are less affected by high temperatures.

Use the information above to predict the structures and bonds present in the cell membranes of archaea giving reasons for your prediction. [3]

.....

.....

.....

.....

.....

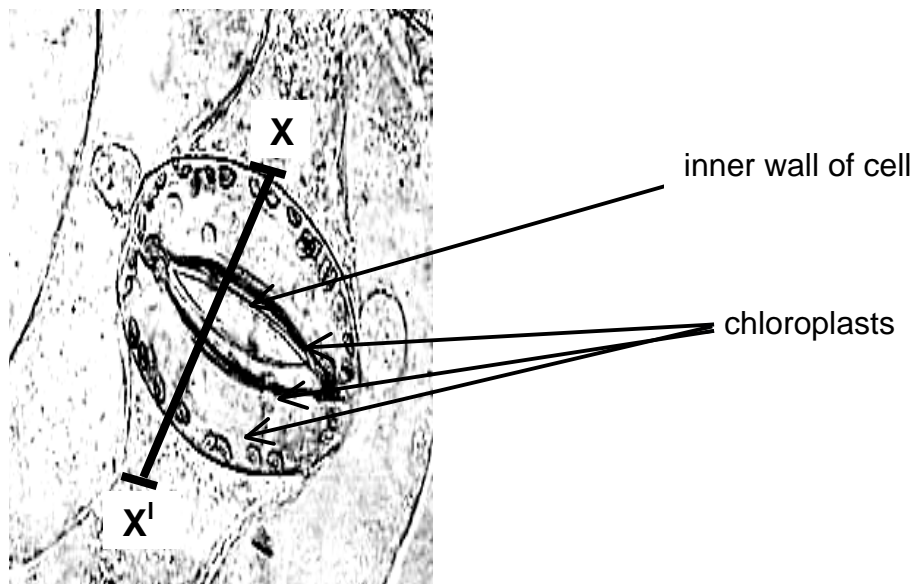
.....

.....

.....

2. *Fusicoccum amygdali* is a parasitic fungus of peach trees and related species. The hyphae grow in the air spaces of plant tissues and enter through wounds or open stomata. The stomata in leaves are essential for gas exchange in plants. The guard cells can open or close stomata to control water loss from the plant.

The picture below shows the appearance of these cells when the stoma is open.



- (a) The maximum length of the cells at line X-X' is 65 μm . Calculate the magnification of the image. Show your working and give your answer to three significant figures. [3]

Magnification of image =

- (b) The fungus produces a toxin called fusicoccin that causes cells to increase their uptake of potassium ions.
- (i) Explain how fusicoccin could affect the guard cells of stomata. [2]

.....

.....

.....

- (ii) Explain the biological advantage to the fungus of secreting this toxin? [2]

.....

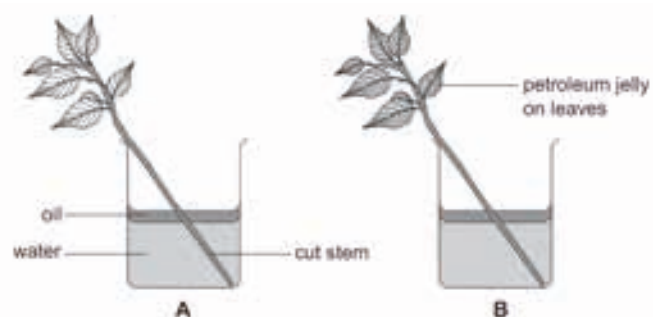
.....

.....

.....

- (c) Students were asked to set up an experiment to investigate water loss by a plant. The instructions are given below.

- cut two leafy shoots
- cover the leaves of one shoot with petroleum jelly (Vaseline)
- place the shoots in separate beakers of water and cover surface of water with oil
- record the total mass of each experimental setup
- expose the shoots to light and weigh them again at 30 minute intervals for 5 hours.



The students observed that the mass of the shoot with petroleum jelly on its leaves lost less water than the shoot with no petroleum jelly.

- (i) The students concluded that the mass of water lost from the shoot was equal to the mass of water absorbed by the shoot. Explain why the pupils would be incorrect in reaching this conclusion. [2]

.....

.....

.....

- (ii) Describe how you could adapt this method to identify which surface of the leaves has the highest density of stomata and explain how you would use the results of your experiment to reach your conclusion.

[5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

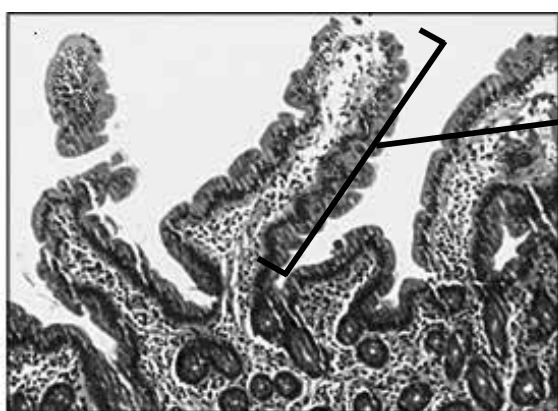
14

3. Coeliac disease is a common digestive condition where a person has an adverse reaction to gliadin, a component of the protein gluten, which is found in wheat. Most proteins are digested by a range of protease enzymes into short peptides made of only two to three amino acids. Gliadin is digested by both pepsin and trypsin but results in longer peptide chains than usual and it is believed that these trigger coeliac disease.

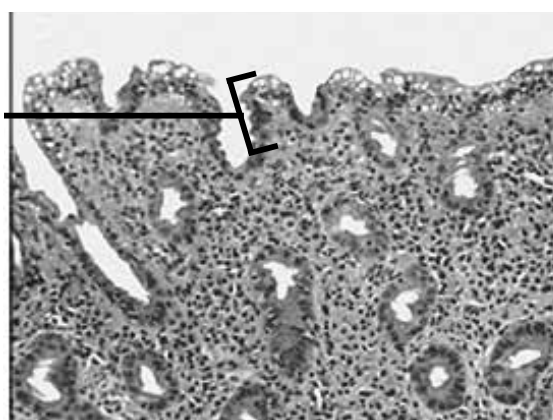
Symptoms of coeliac disease include weight loss and fatigue in adults and poor growth rates in children. These symptoms are related to the effects of coeliac disease on the lining of the ileum.

The photomicrographs below show sections through the ileum of a person without coeliac disease and a person suffering from coeliac disease.

Person without coeliac disease



Person with coeliac disease



villus

- (a) Pepsin and trypsin are enzymes involved in the digestion of proteins into short chain peptides.

- (i) Explain how pepsin and trypsin digest proteins into short chain peptides. [2]

.....

.....

.....

- (ii) Explain why pepsin and trypsin are secreted as precursor molecules and state how they are activated. [3]

.....

.....

- (b) Explain how coeliac disease can cause fatigue in adults and poor growth rates in children suffering from this disease. [4]

.....

.....

.....

.....

.....

.....

.....

.....

- (c) Coeliac disease can also lead to osteoporosis (brittle bones). Dairy products are good natural sources of calcium.

Teenage boys have a recommended calcium intake of 1050 mg per day. Drinking 200 cm³ of milk would provide a teenage boy with 24% of his recommended daily allowance.

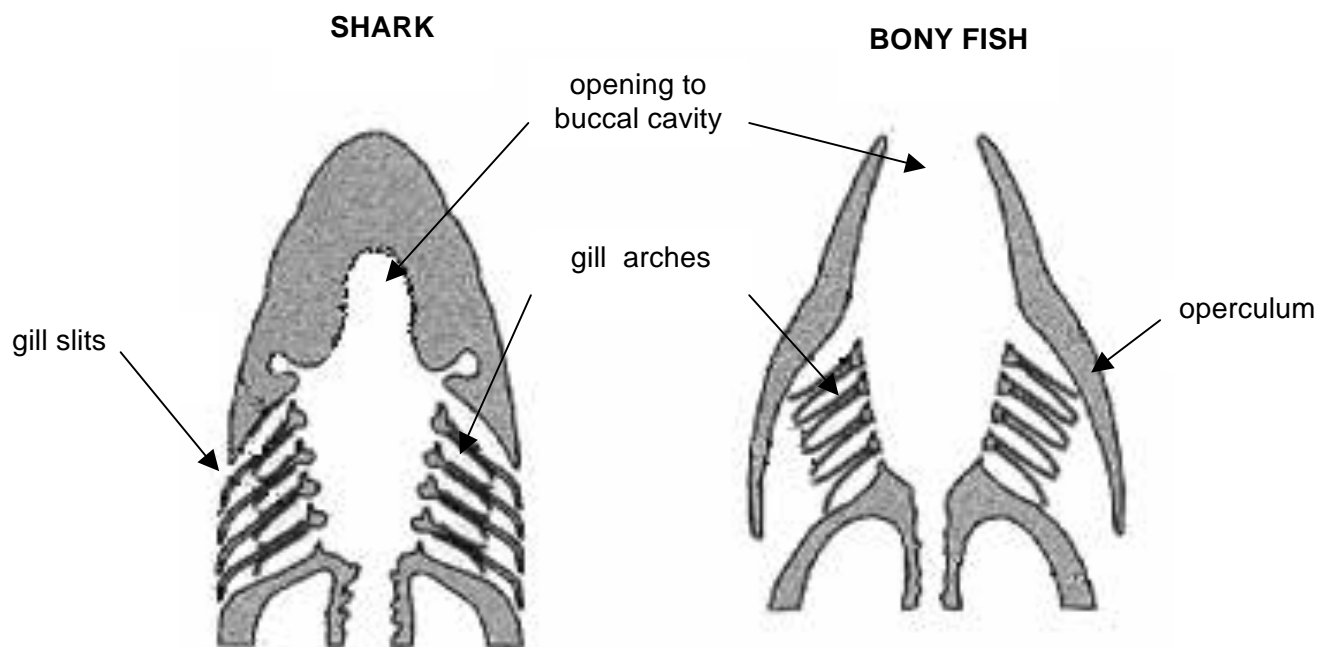
Calculate the volume of milk he would need to drink each day to reach his recommended daily allowance of calcium, if this was his only source of calcium. [2]

Volume of milk =

4. The oxygen content of water is affected by temperature as shown in the table below.

Temperature-Oxygen Solubility Relationship	
Temperature (°C)	Oxygen Solubility (mg/L)
0	14.6
5	12.8
10	11.3
15	10.2
20	9.2
25	8.6
100	0

All fish use gills for oxygen uptake and rely on them being efficiently ventilated. The diagrams below show the arrangement of the gills in a typical shark and a typical bony fish.



- (a) State the difficulties faced by aquatic organisms in obtaining oxygen from water, when compared to terrestrial organisms. [2]

.....

.....

.....

- (b) (i) In cartilaginous fish, such as sharks, a parallel flow system operates in the gills and in bony fish such as mackerel a counter current flow system is found.
Explain what is meant by the terms *parallel flow* and *counter current flow* and state why the counter current system is more efficient. [3]

Parallel flow

.....
.....
.....

Counter current flow

.....
.....
.....

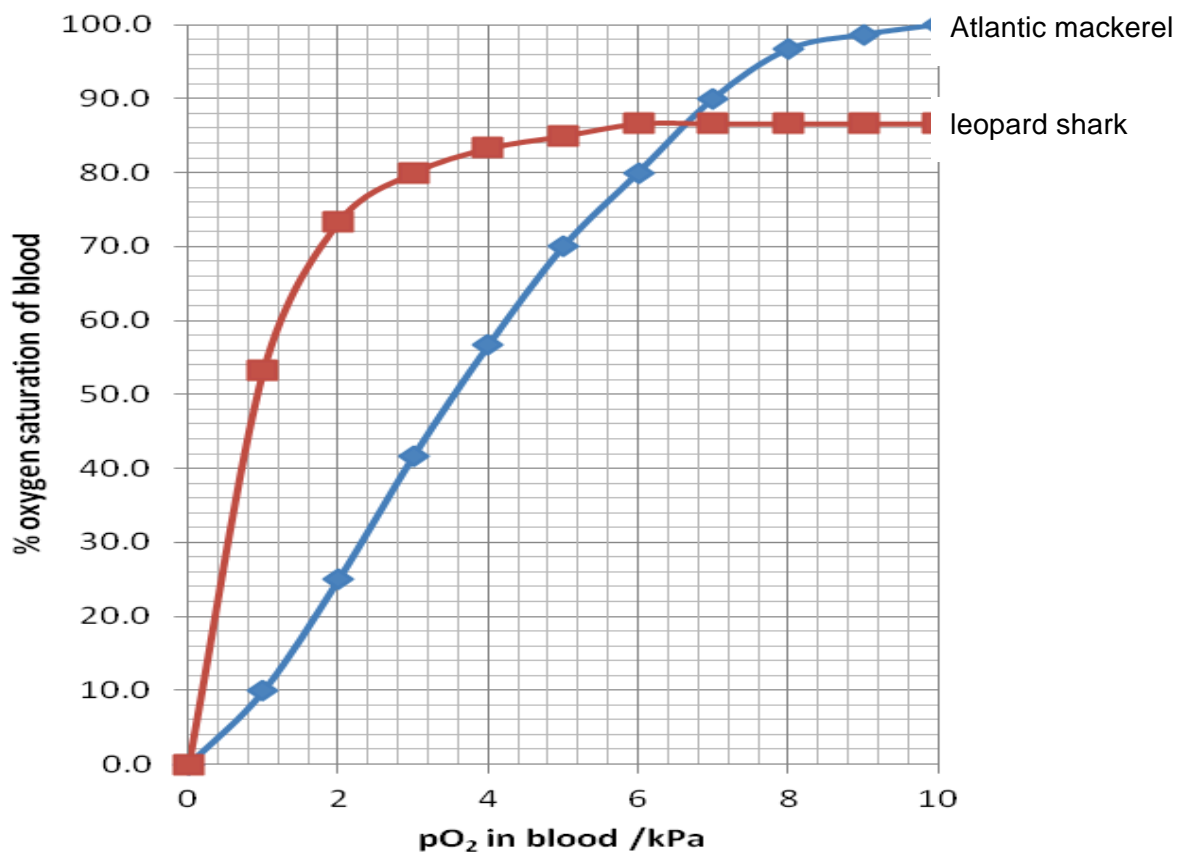
Reason why counter current flow is more efficient

.....
.....
.....

- (ii) Some sharks will die if they are trapped in a net and cannot swim.
Suggest how these sharks would normally ventilate their gills. [1]

.....
.....

- (c) Atlantic mackerel are highly active, bony fish that hunt and live in the cold waters of the northern Atlantic Ocean. The leopard shark lives in warm waters off the Pacific coast of North America and feeds on slow moving animals on the sea-floor.
The graph below shows the oxygen dissociation curves for the Atlantic mackerel (*Scomber scombrus*) and the leopard shark (*Triakis semifasciata*).



Use all the information provided to explain the differences in the habitat and level of activity of the Atlantic mackerel and the leopard shark. [5]

.....

.....

.....

.....

.....

.....

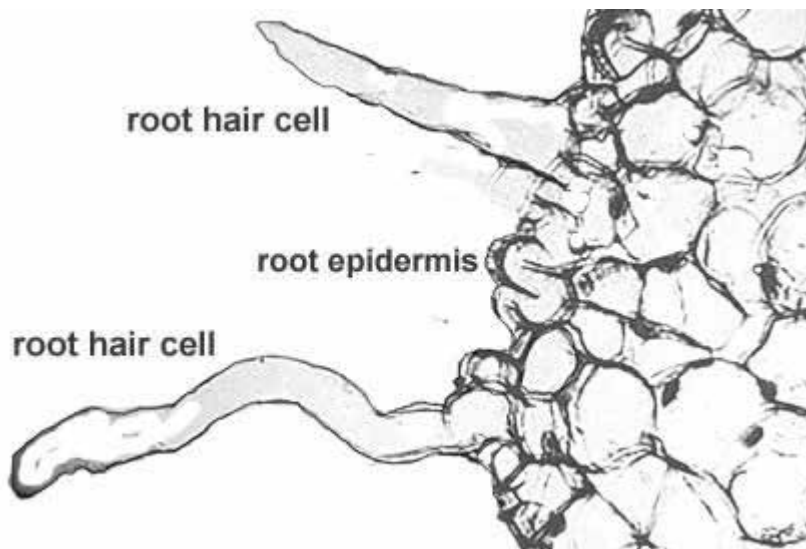
.....

.....

.....

.....

5. Plants take up mineral ions through their roots by active transport. For this to take place the mineral ions need to come into contact with the cell membranes of root hair cells and do this by diffusion through soil water or by the flowing of water through the soil and past the root hair cells.
The image below shows two root hair cells.



Root hair cells have several features to increase their ability to take up substances from the soil.

- (a) (i) Name **two** mineral ions that plants take up through the root hair cells. [1]

..... and

- (ii) Complete the table below to explain how the features above increase the efficiency of uptake of ions from the soil. [3]

feature	reason
thin walled	
large number of mitochondria	
thin cuticle	

- (b) Root hair cells also absorb water from the soil. The diagram below shows the two main pathways taken by water as it passes from the root hair cell into the vascular tissue.

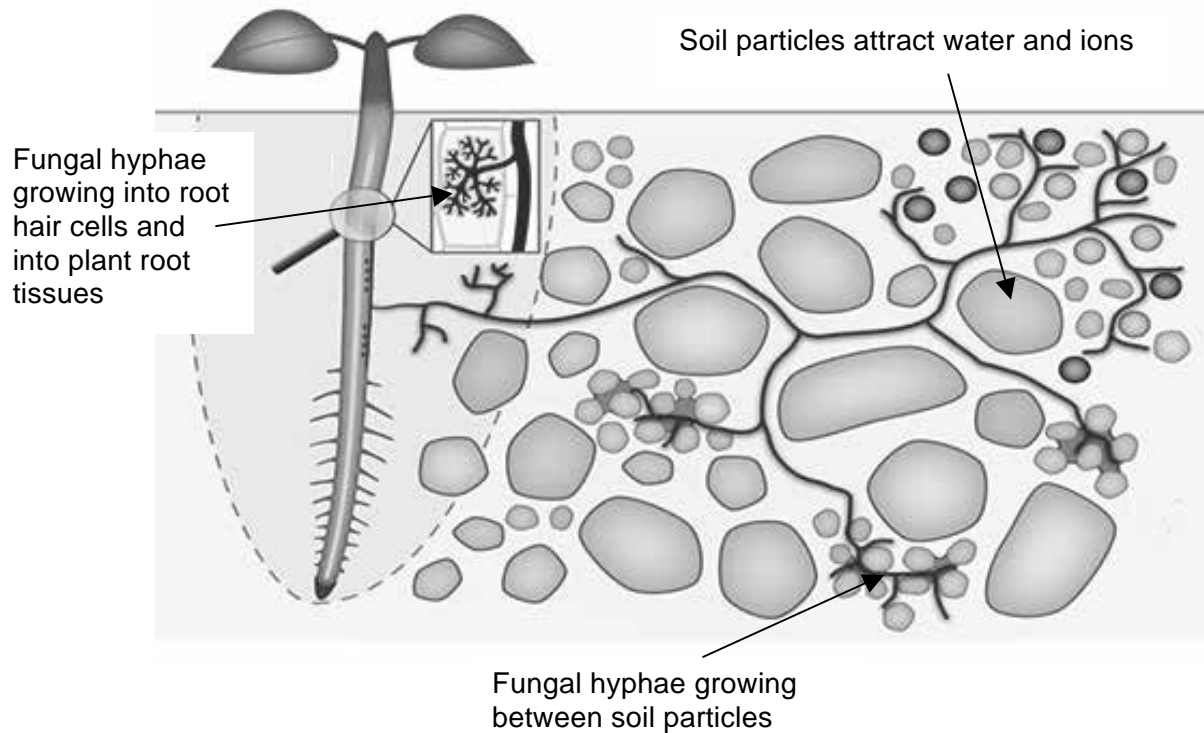


- (i) Label the **two** pathways shown on the diagram above, . [1]
- (ii) At point **X** on the diagram both pathways pass through the same part of the cell. Explain why this occurs. [1]

.....

.....

- (c) It is difficult for plants to get access to all the minerals they need because the mineral ions bind to the surface of soil particles. Many plants have evolved mutualistic relationships with fungi. Fungal hyphae can be very long and extend in a branching network through large volumes of soil. In addition, their cell walls are highly absorbent. Hyphae of the fungi grow around and into the root hair cells and can grow between cells of the root eventually reaching and penetrating tissues in central vascular bundle.



Explain how the plant and the fungus both benefit from this relationship. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (d) Some scientists have concluded that the relationship between fungi and plants could be classed as a form of parasitism. On what basis could this conclusion be reached? [1]

.....

- (e) Lichens are organisms that are an association of unicellular plants called algae, and hyphae of a fungus. They grow on rocks or trees and are found on all continents. The following observations were made on cultures of fungi and algal components isolated from lichens.

- the fungal component grows slowly on nutrient media
- some fungal components of tree lichens have been found to secrete cellulase enzymes and some that grow on rocks secrete a weak acid
- most fungal components are deficient in the vitamin thiamine
- the algal component grows well on glucose rich culture media
- the algae can grow in the dark as long as glucose is provided
- most algae isolated from lichens have been found to secrete vitamins, including thiamine, into the culture medium

Identify the modes of nutrition shown by the algal and fungal components of a lichen giving reasons for your answers. [4]

Algal component

.....

Fungal component

.....

6. The Great Barrier Reef in Australia has been recognised as being a **biodiversity hotspot**. It contains more than 2 900 individual reefs and has over 900 islands stretching for approximately 2 600 kilometres along the east coast of the continent.

- (a) State what is meant by the term **biodiversity**. [1]

.....

.....

The crown-of-thorns starfish (*Acanthaster planci*) is a coral eating starfish native to coral reefs in Australia and other parts of the Pacific Ocean. In recent years there has been a major increase in the number of these starfish resulting in the destruction of large areas of live coral and a decrease in the biodiversity of the reef.

To estimate the population of these animals, scientists counted all the visible starfish in ten transects, each 100m long x 2m wide, at five different places on each reef to give a total area of 10 000m². This survey was repeated on five different reefs and the results used to calculate a mean population number of the crown-of-thorns starfish.

Surveys are carried out on a regular basis and an outbreak is declared when the number of adult starfish exceeds 3 000 per km².

The results of one survey are shown below.

Transect	1	2	3	4	5
Number of Adult crown-of-thorns starfish per 10 000m²	11	42	37	26	21

- (b) Use these results to estimate the number of starfish per km². Show your workings. [3]

Estimated number of crown-of-thorns starfish per km² =

- (c) Based on these results, the scientists concluded that they were not facing an outbreak of the crown-of-thorns starfish.

Evaluate the strength of their evidence and hence the validity of their conclusion. [4]

.....

.....

.....

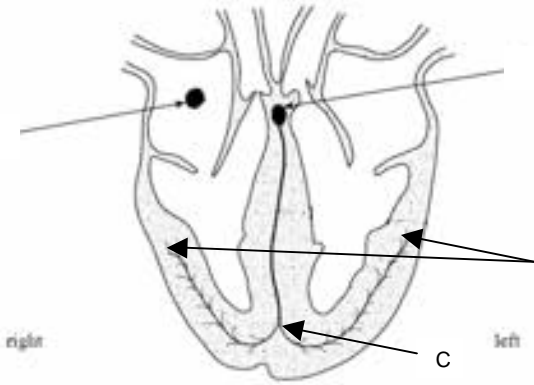
.....

.....

.....

8

7. Contraction of the human heart is controlled to ensure that blood flow through the heart is maintained so that tissues are provided with blood. Contraction of the heart is caused by a wave of excitation that passes from A to D on the diagram below. The table shows the timing of a wave of excitation as it passes from **A** to **D**.



Sequence of transmission of wave of excitation	Time from start of wave of excitation (s)
Leaves A	0.000
Arrives at B	0.045
Leaves B	0.165
Arrives at C	0.205
Arrives at D	0.245

Using all the information above and your knowledge of the structure of the heart, describe and explain the effect of this wave of excitation on blood flow through the heart and the significance of the times shown in maintaining efficient blood flow. (The quality of your extended response will be assessed in this question. [9QER])

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

