WJEC (Wales) A-level Biology
Topic 2.4 Adaptations for Nutrition
Questions by Topic

1. Define the following terms and give an example of a different organism for each.

[6]

Parasite

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Example

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Autotroph

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Example

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Saprophyte or saprobiont

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Example

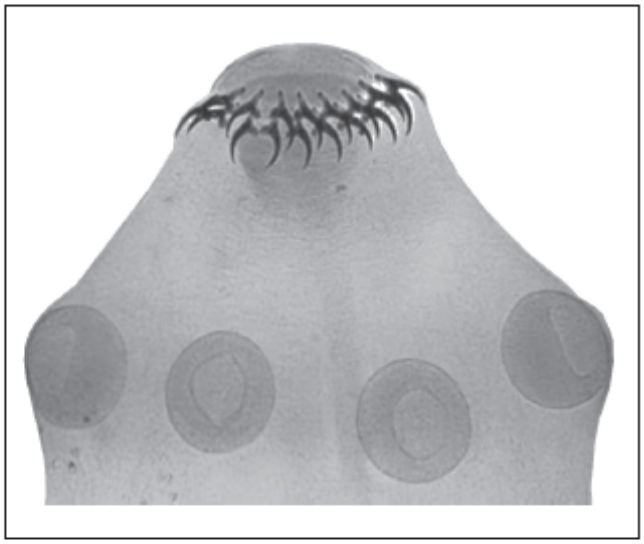
.....

(Total 6 marks)

2. The diagrams below show the gut parasites Taenia solium and Echinococcus granulosus (A) and the skull of a mammal (B).

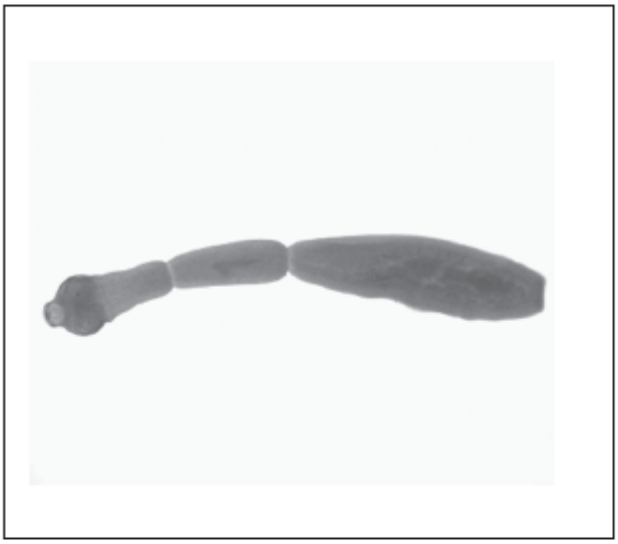
A

Taenia solium



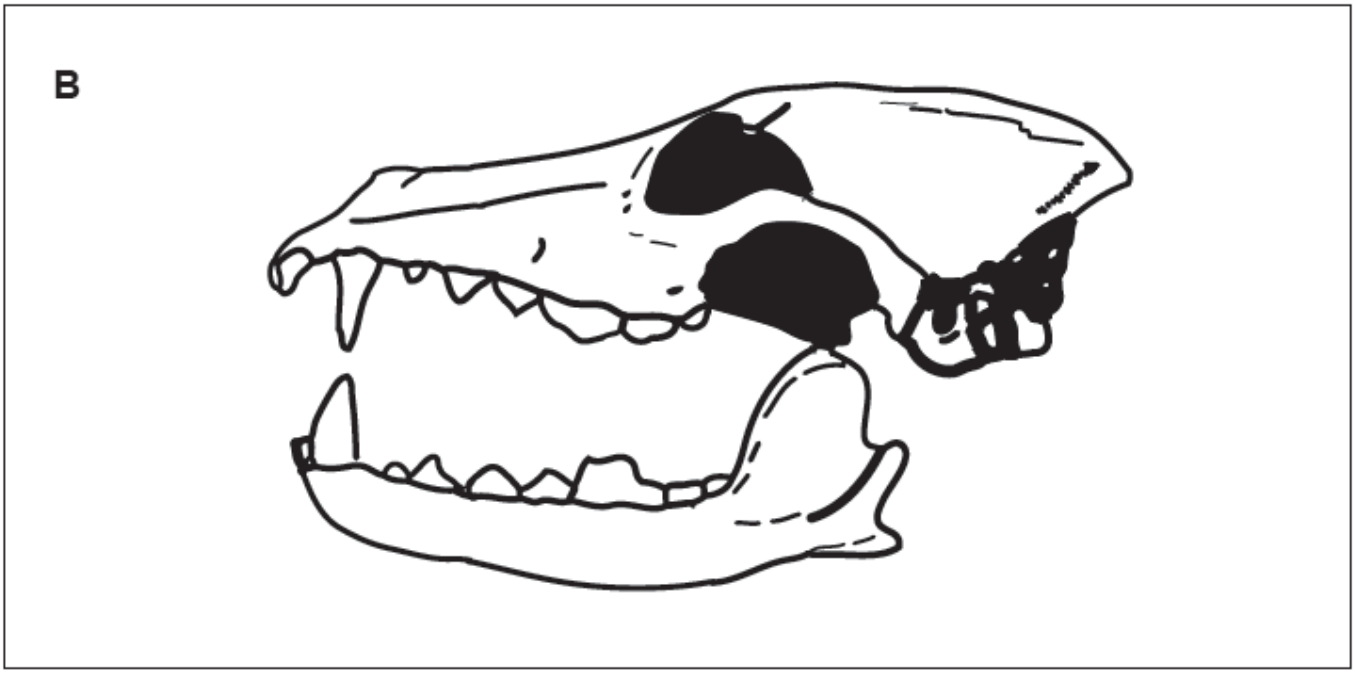
http://www.k-state.edu

Echinococcus granulosus



http://bioweb.uwlax.edu

B



(a) (i) State what is meant by the term parasite.

[2]

(ii) Using the photographs in A opposite, and your own knowledge, state three features of the gut parasites that are adaptations to their parasitic way of life.

[3]

(iii) State the type of diet eaten by the animal shown in diagram B opposite. Give reasons for your answer.

[3]

(b) Explain how a parasitic mode of nutrition is

(i) similar to the mode of nutrition used by the mammal in diagram **B** opposite,

[1]

(ii) different from the mode of nutrition used by the mammal in diagram B opposite.

[2]

3. Organisms display a wide range of feeding mechanisms. For example, *Amoeba* are holozoic and feed by ingesting food particles which are digested intracellularly, whereas fungi are saprotrophic.

(a) Define the term *saprotrophic*. [1]

……

……

(b) The parasitic tapeworm *Taenia solium* is an endoparasite that completes its life cycle in two different species of animal, humans and pigs. As an adult, *T. solium* lives in the human intestine. The tapeworm has no mouth or alimentary canal and relies on anaerobic respiration to provide energy.

(i) Describe how the tapeworm is adapted to resist peristalsis in the human intestine. [1]

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(ii) Explain why the tapeworm does not need a mouth or alimentary canal. [2]

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(iii) Suggest why the tapeworm relies on anaerobic respiration for its metabolism. [1]

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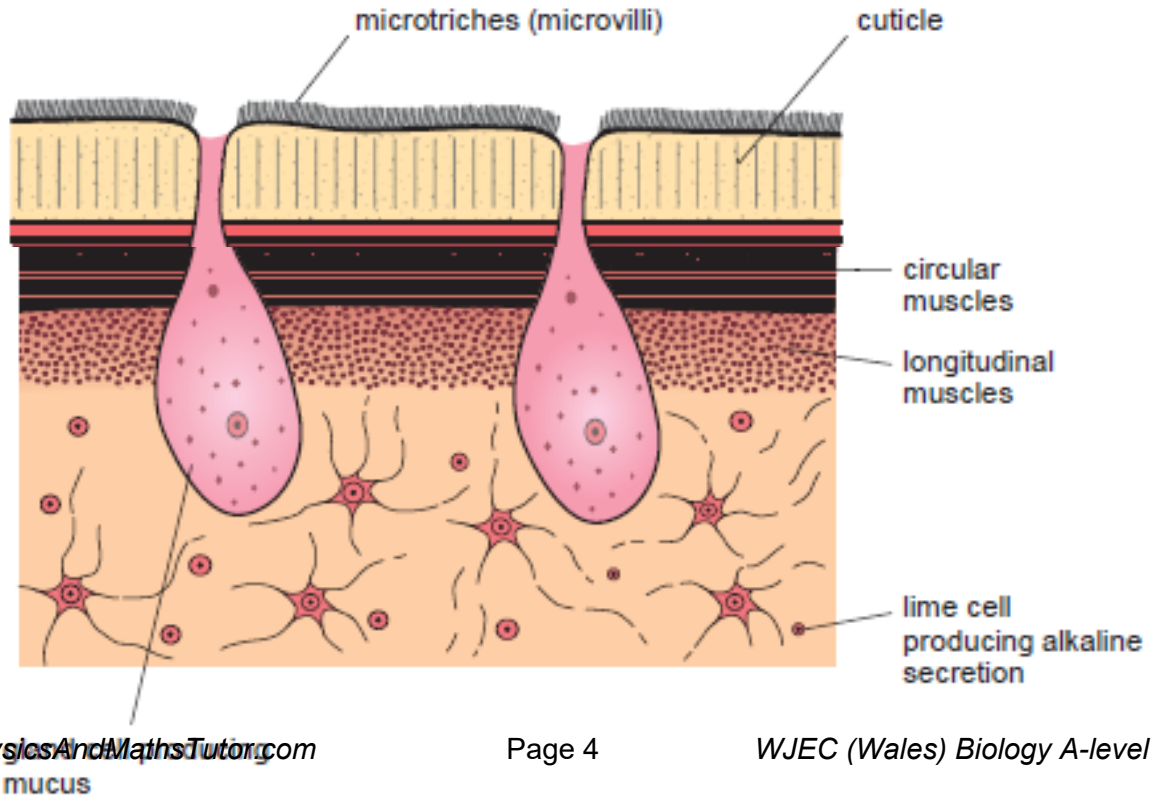
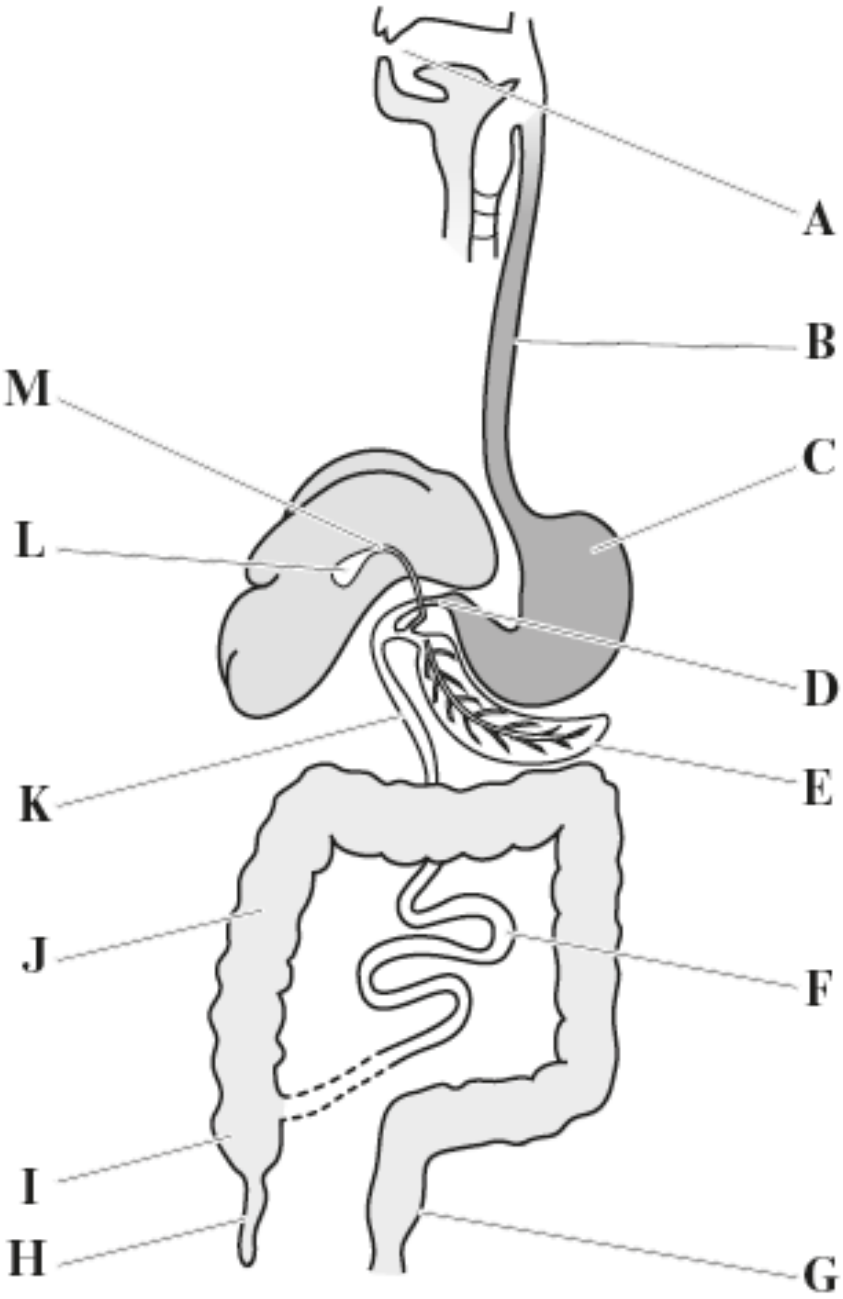
(c) The diagram below shows a section of the tapeworm's body wall.



(i) Describe and explain how the adaptations visible in the diagram enable the tapeworm to survive in the environment within the host. [4]

(ii) Body wall cells of *T. solium* have been observed to contain transmembrane proteins involved in active transport mechanisms. Suggest how these mechanisms aid the survival of the parasite within its host. [2]

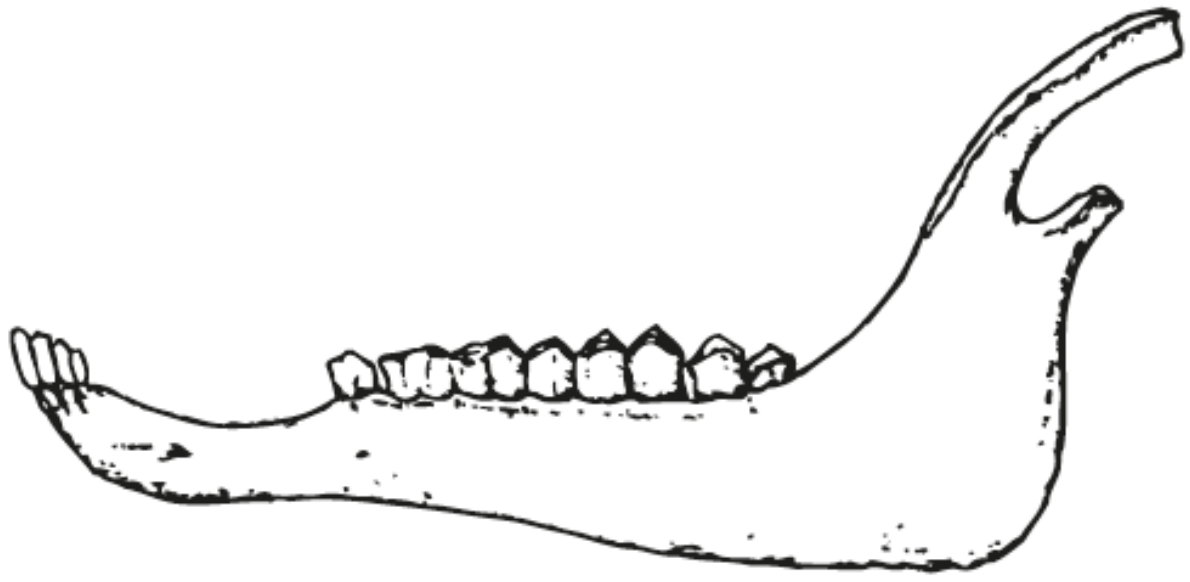
4. The diagram below shows the human alimentary canal.



(a) Use a letter or letters from the diagram above to answer the following questions.

(i)	Which is the most acidic region of the alimentary canal?	
(ii)	In which **two** areas are proteins, carbohydrates and lipids digested together?	
(iii)	Where does the process of protein digestion begin?	
(iv)	Where is the main site of lipase production?	
(v)	The section of the alimentary canal where most absorption of digested products occurs.	
(vi)	The section of the alimentary canal whose main function is to absorb water.	

The diagram below shows the lower jaw of a mammal.



(b) Use the information in the diagram above to:

(i) State the name given to describe the mode of nutrition of this mammal. [1]

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(ii) Explain how the jaw and teeth shown above are adapted for this mode of nutrition.

[3]

(iii) Explain how the **gut** of this mammal is adapted for digestion.

[2]

5. Domestic dogs evolved from wolves between 10 000 and 30 000 years ago. Both are adapted to feed mainly on a carnivore diet. Recent studies into dogs and wolves have shown that the ancestors of domesticated dogs produced enzymes involved in starch digestion which are not produced by wolves. It has been proposed that dogs might have developed the ability to digest starch after they were domesticated by humans.

Explain how wolves and dogs are both adapted to feed mainly on a carnivore diet. Describe the process of starch digestion and suggest the advantage to domesticated dogs of being able to digest starch. [9 QER]

6. The tapeworm, *Taenia solium*, is a parasite of humans.

(a) State what is meant by the term *parasite*.

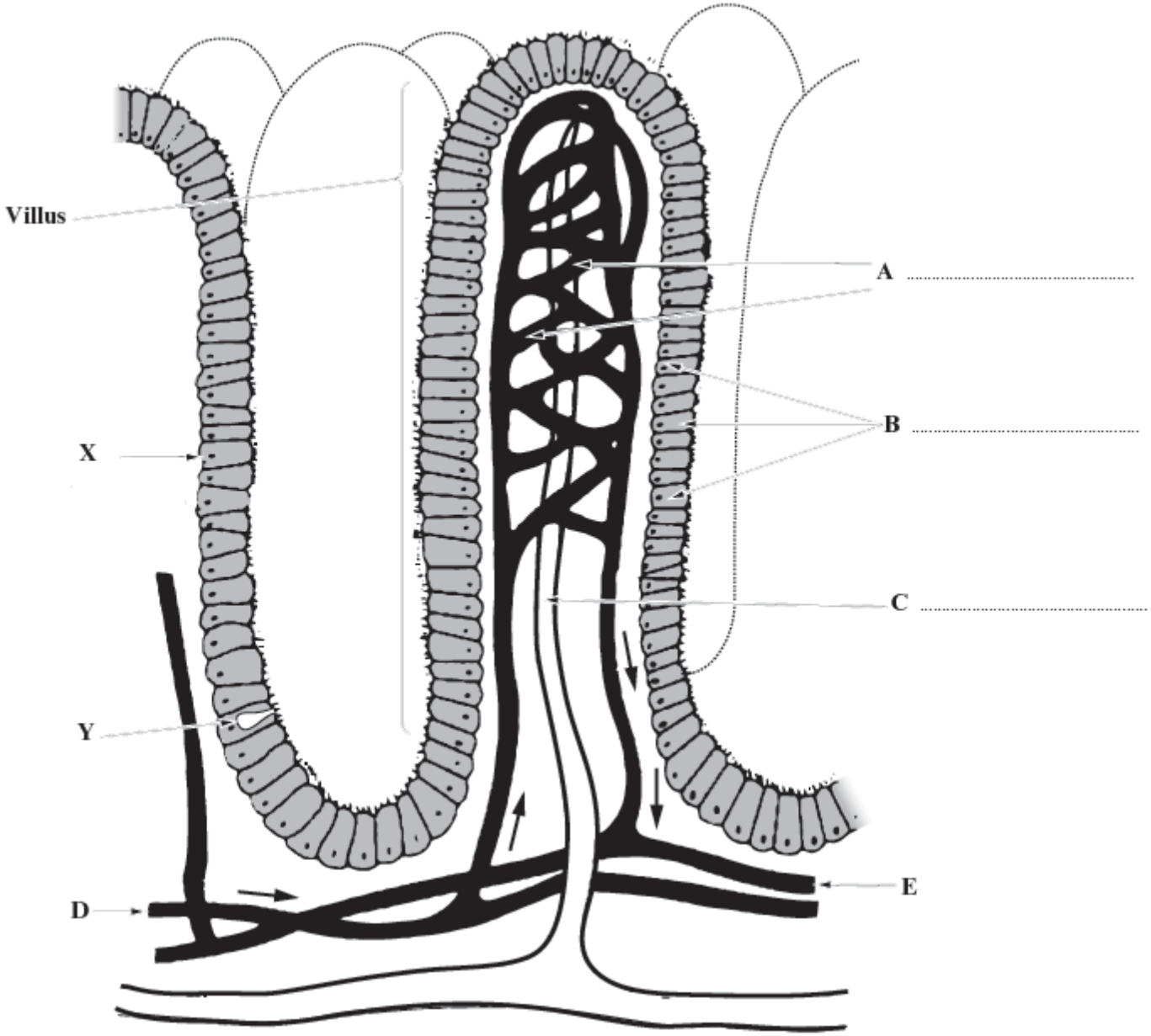
[2]

The tapeworm consists of a head with no mouth, followed by a large number of thin flat segments called proglottids.

(b) Describe how the tapeworm is adapted to obtain its nutrients.

[3]

7. The following diagram shows a longitudinal section of the small intestine.



(a) Complete the diagram by labelling structures A, B and C.

[3]

(b) Identify the types of blood vessels shown by D and E.

[2]

D

.....

E

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(c) Describe two features associated with cell X and explain why each is important for the cell to function efficiently.

[4]

Feature 1

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Importance

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Feature 2

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Importance

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(d) Cell Y is vital to the functioning of the intestine. What is the name of this cell and what is its function?

[2]

Name

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Function

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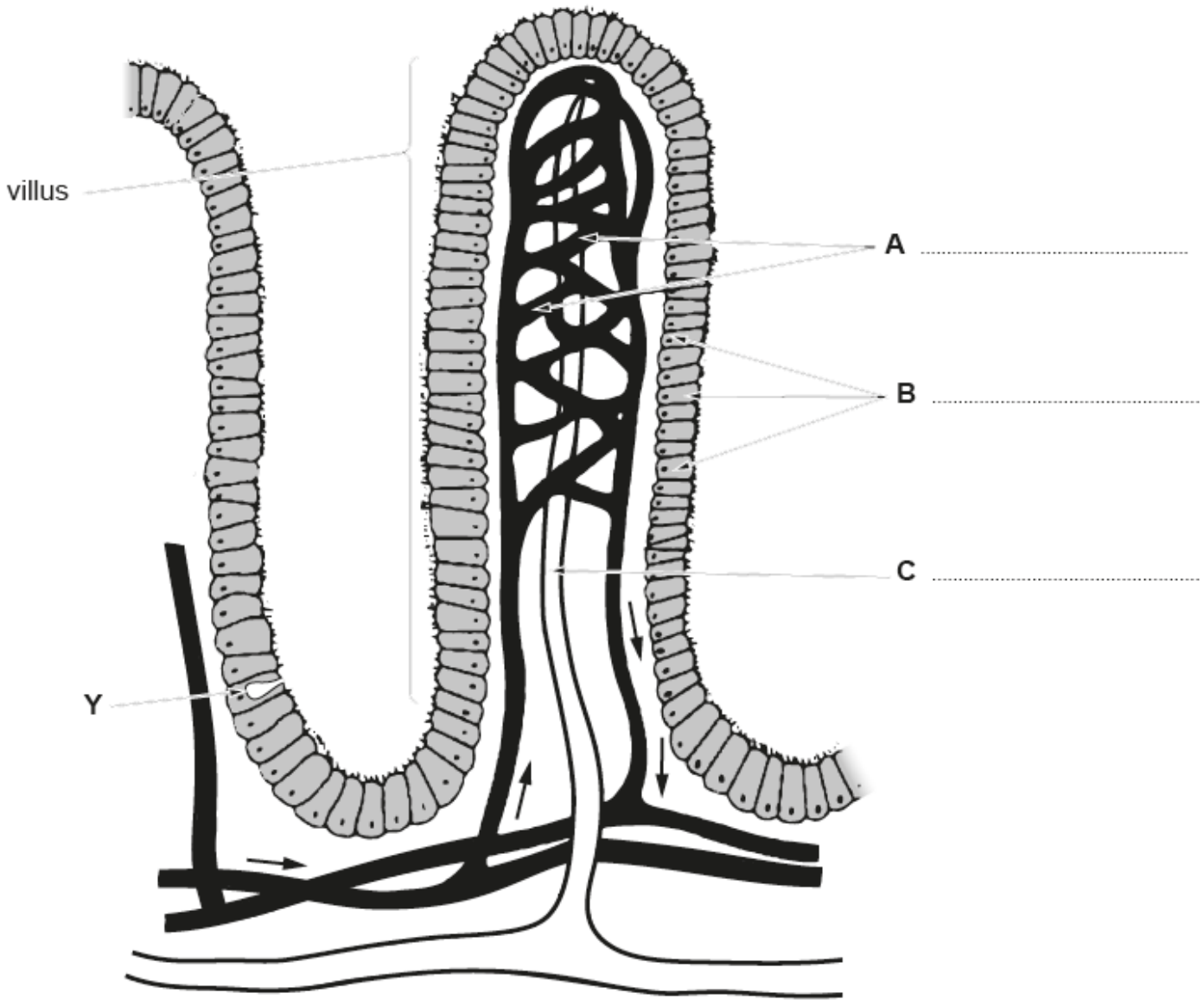
8. The diagram below shows a villus of the small intestine.



(a) Complete the diagram above by naming the structures **A**, **B** and **C**.

[3]

(b) With reference to the diagram **only**, describe and explain **two** features that are important in the functioning of the villus.

[4]

(c) (i) Name the substance secreted by cell type **Y**.

[1]

(ii) Explain **two** functions of the secretion of cell type **Y** in the process of digestion.

[2]

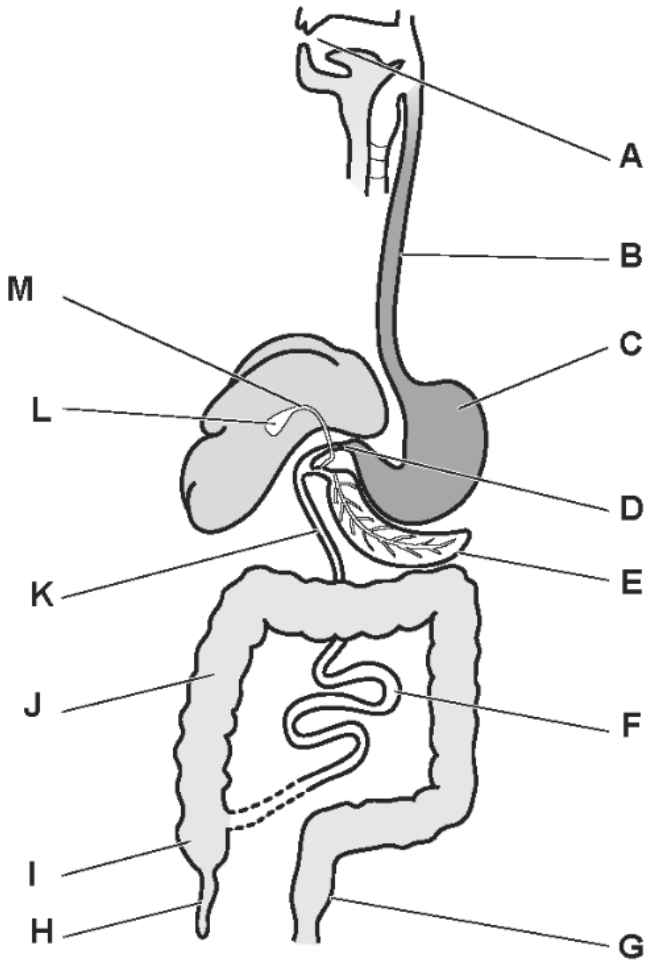
(d) Layers of smooth muscle are found in the wall of the small intestine. Explain the role of these muscle layers in the process of digestion.

[3]

(e) Amino acids absorbed by structure **A** are transported to the liver. Describe the fate of the **excess** amino acids absorbed.

[2]

9. Below is a diagram of the human gut.



(a) Using the letters from the diagram, indicate where the following occur. (Letters may be used once, more than once or not at all.) [4]

	Letter(s)
The main sites of mechanical digestion	
The site of lipase production	
The chemical digestion of protein begins	
The final stages of carbohydrate digestion	

(b) The liver produces bile which contains both bile salts and hydrogen carbonate ions. Bile is stored in the gall bladder and is secreted into the duodenum. Bile salts emulsify lipids by breaking large lipid droplets into many smaller lipid droplets.

(i) Explain the importance of this process in the digestion of lipids. [2]

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(ii) Using your knowledge of digestion, suggest a function of the hydrogen carbonate ions. [1]

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(c) Humans are the primary host of the pork tapeworm, *Taenia solium*.

(i) Draw a labelled arrow on the diagram opposite to show where the adult tapeworm would be located. [1]

(ii) Using your knowledge of the tapeworm, explain why the tapeworm would be located in this region. [2]

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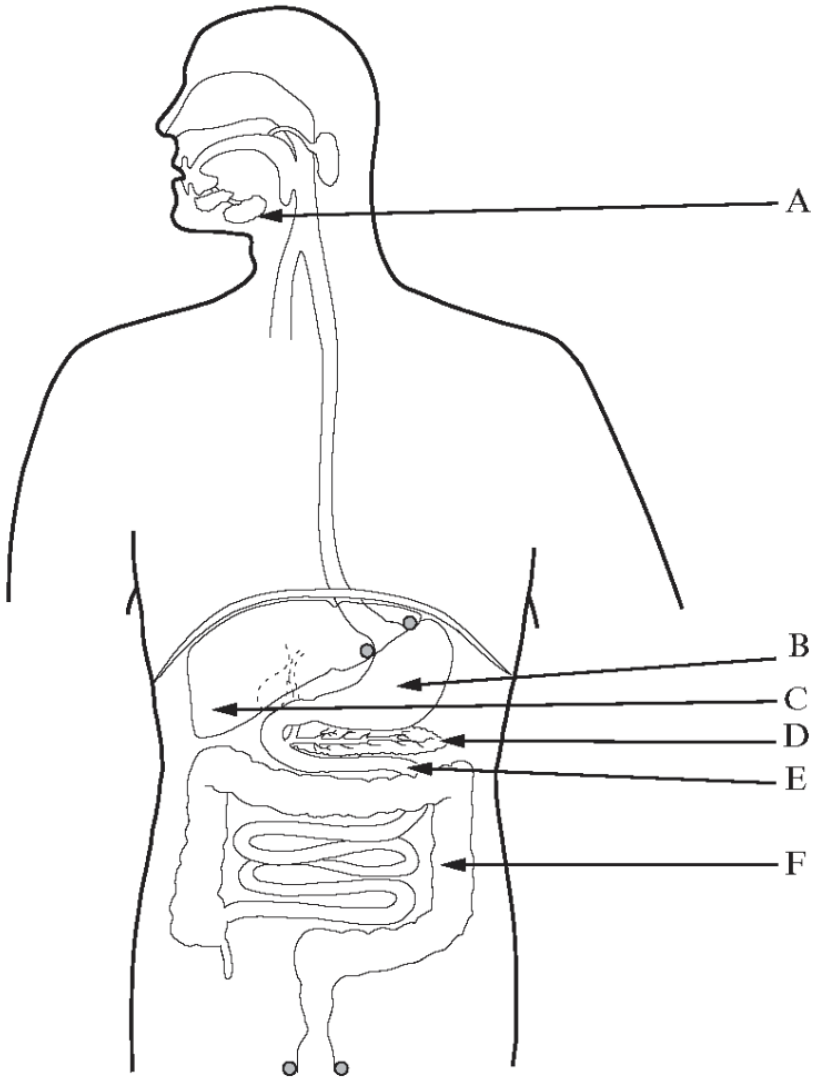
10

10. The diagram represents the human digestive system.



(a) Using the appropriate letter(s), A-F shown on the diagram, complete the following statements. [4]

An acidic region ☐

The region where the hydrolysis of protein begins ☐

Two regions where the enzyme amylase is produced ☐

The structure which produces chemicals which emulsify fats ☐

(b) In the villi of the small intestine what is the function of:

(i) the lacteal, [1]

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(ii) the capillaries, [1]

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(iii) the smooth muscle cells? [1]

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(c) The symptoms of Coeliac disease include severe weight loss, deficiency diseases such as anaemia and a range of symptoms caused by increased bacterial activity in the large intestine. Suggest why the patient shows these symptoms. [4]

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(d) Patients with colon cancer may have their colon surgically removed (total colectomy). Explain why they are likely to suffer from symptoms of dehydration. [1]

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(Total 12 marks)

11. An experiment was carried out to determine the effect of bile salts on the digestion of lipids. After equilibration at 37°C each tube contained:

1 cm^3 enzyme
5 cm^3 full cream milk
2 cm^3 sodium carbonate
6 drops of phenolphthalein pH indicator.

Bile salts were added to tube B and boiled enzyme used in tube C.

In alkaline solutions above pH10 phenolphthalein indicator is pink.
In solutions below pH 8.3 it is colourless.

The colour changes of the solutions are shown in the table below.

	*Tube **A*** *No bile salts*	*Tube **B*** *Plus bile salts*	*Tube **C*** *Boiled enzyme*
Initial colour of indicator in experiment	Pink	Pink	Pink
Colour of indicator after 5 minutes	Pink	Colourless	Pink
Colour of indicator after 10 minutes	Pink	Colourless	Pink
Colour of indicator after 15 minutes	Colourless	Colourless	Pink

(a) Name the enzyme used in this experiment. [1]

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(b) (i) Explain the change in colour of indicator from pink to colourless. [2]

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(ii) Using your knowledge of lipid digestion in the gut, explain the results seen in the tubes **A** and **B**. [3]

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(c) Explain fully the results of tube **C**. [3]

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(d) Suggest why the experiment was carried out using full cream milk. [1]

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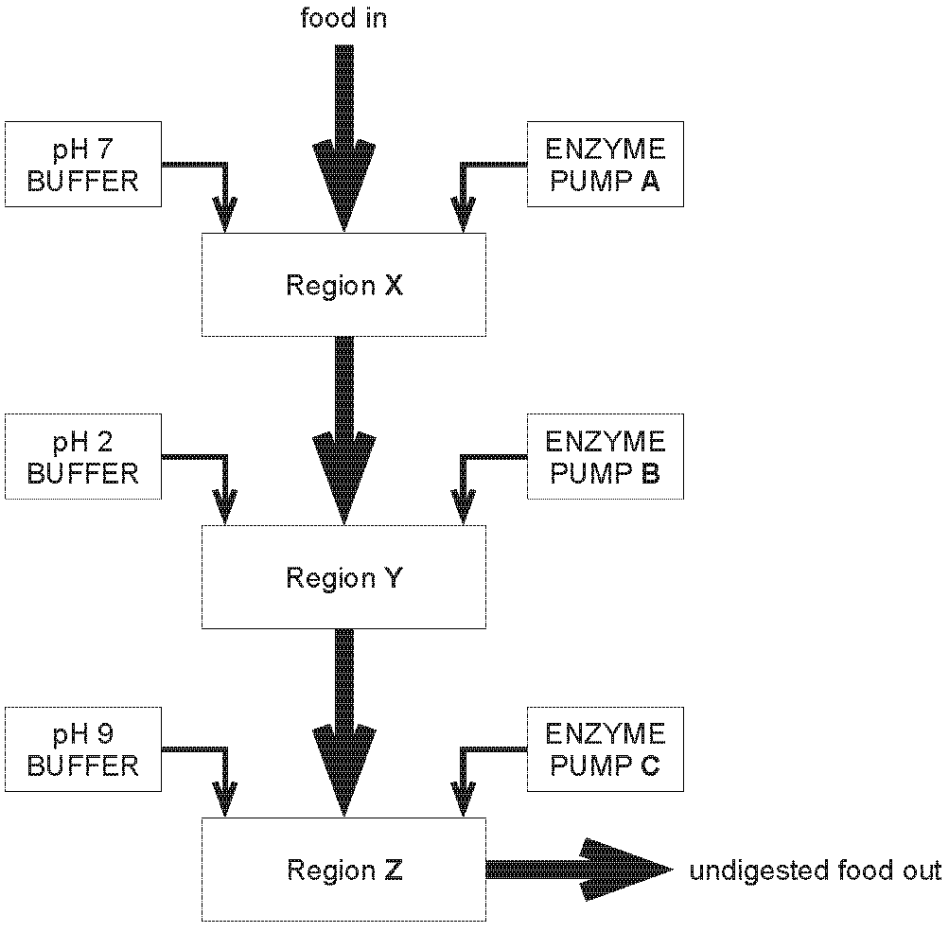
(Total 10 marks)

12. The diagram shows an artificial gut which contains the normal enzymes and micro-organisms found in the human gut. This model allows scientists to follow the digestion of food in detail.



(a) Name the regions of the human gut represented by **X**, **Y** and **Z** in the model gut. [1]

X .....

Y .....

Z .....

(b) Name a carbohydrase added by enzyme pumps **A and C**. [1]

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(c) Some protease enzymes added by enzyme pumps **B** and **C** are added in the form of inactive precursors.

Explain why these enzymes are not secreted in their active form. [1]

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(d) In the artificial gut, the pH of each region is controlled by a pH buffer.
Explain why the pH of each region needs to be kept at a certain pH. [1]

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(e) In the real human gut the pH of region **Z** is partly controlled by bile.
Describe the role of bile in digestion. [2]

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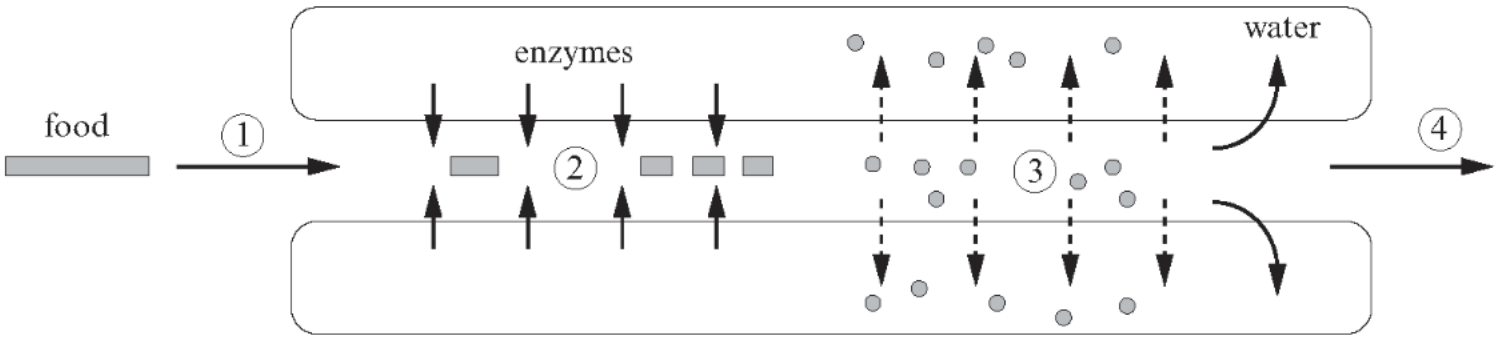
13. The diagram shows the processes that would take place in a simple tube gut.



(a) (i) Name the processes numbered 1-4. [2]

1. .....

2. .....

3. .....

4. .....

(ii) Define the process numbered 3. [1]

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(b) (i) Explain why the digestion of proteins is more efficient if they are exposed to endopeptidases before being acted upon by exopeptidases. [2]

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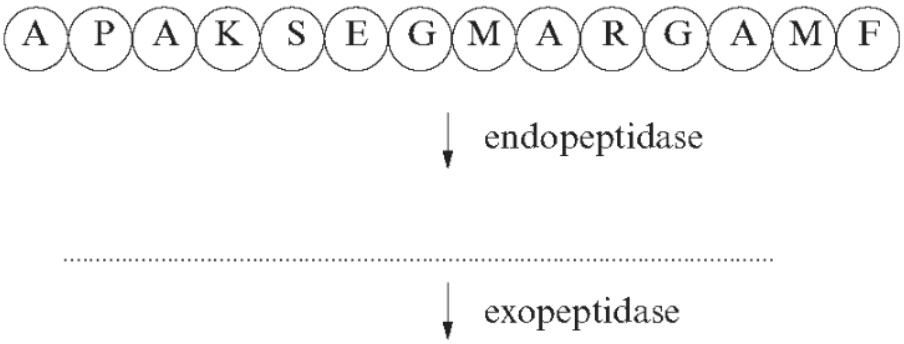
(ii) Figure 1 shows a peptide. Each circled letter represents a single amino acid.

Figure 1

This peptide was digested first with endopeptidase and then with an exopeptidase.
Endopeptidase hydrolyses peptide bonds on the C-terminal side of either the amino acid R or the amino acid K.
Exopeptidase hydrolyses one amino acid at a time from the C-terminal end of a peptide, but will not hydrolyse a dipeptide.
Complete figure 2 to show digestion of this peptide as described above. [2]

Figure 2



(c) Coeliac disease in humans is caused by a protein, gluten, found in wheat, barley and rye. It leads to a loss of villus height and a breakdown of microvilli.

(i) Explain why people with coeliac disease sometimes suffer from deficiency diseases. [2]

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(ii) Explain the reduced efficiency of digestive enzymes, such as those involved with the final breakdown of dipeptides, in people with coeliac disease. [1]

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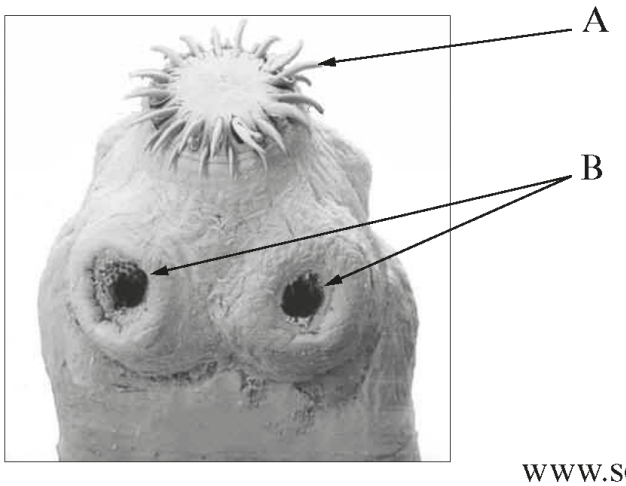
(Total 10 marks)

14. The electron micrograph below shows the head of *Taenia solium* (pork tapeworm).



www.sciencephoto.com

(a) Name structures A and B and explain their importance to the life of the tapeworm. [3]

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(b) Explain why the tapeworm has a very simplified digestive system. [3]

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(c) The adult tapeworm's respiration is mainly anaerobic.
Suggest why the tapeworm respires anaerobically. [1]

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15. Digestion involves the breaking down of food by a combination of mechanical and chemical processes.

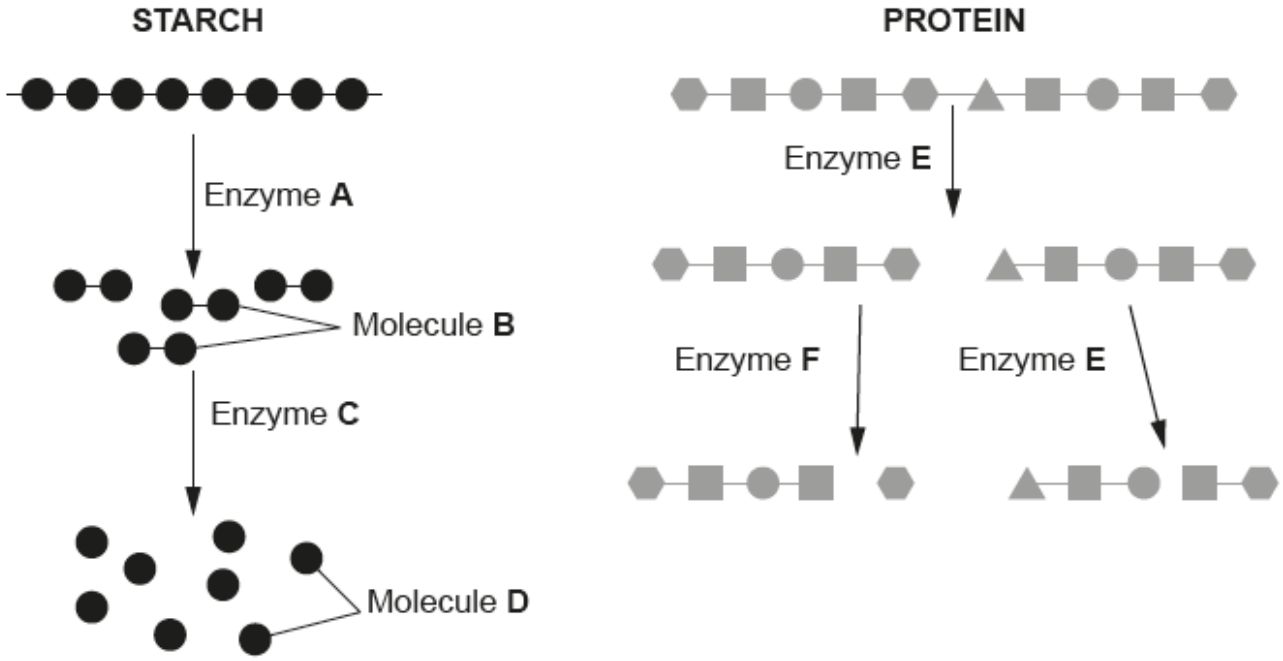
(a) Describe **two** ways in which food is broken down **mechanically** in the human alimentary canal.

[2]

I. . . . . .

II. . . . . .

(b) The diagrams show the digestion of a molecule of starch and a molecule of protein.



(i) In the digestion of starch name:

Enzymes **A** and **C**: [1]

A . . . . . **C** . . . . . .

Molecules **B** and **D**: [1]

B . . . . . **D** . . . . . .

(ii) Name **two** places in the alimentary canal where digestion caused by enzyme A takes place. [1]

. . . . . .

(c) (i) In the digestion of protein name the **types** of enzyme shown at **E** and **F**. [2]

E . . . . . .

E . . . . . .

F . . . . . .

(ii) Pepsin and trypsin are enzymes involved in the digestion of proteins. Both are secreted as inactive precursors. Complete the table to give the names of the substances responsible for their activation.

[2]

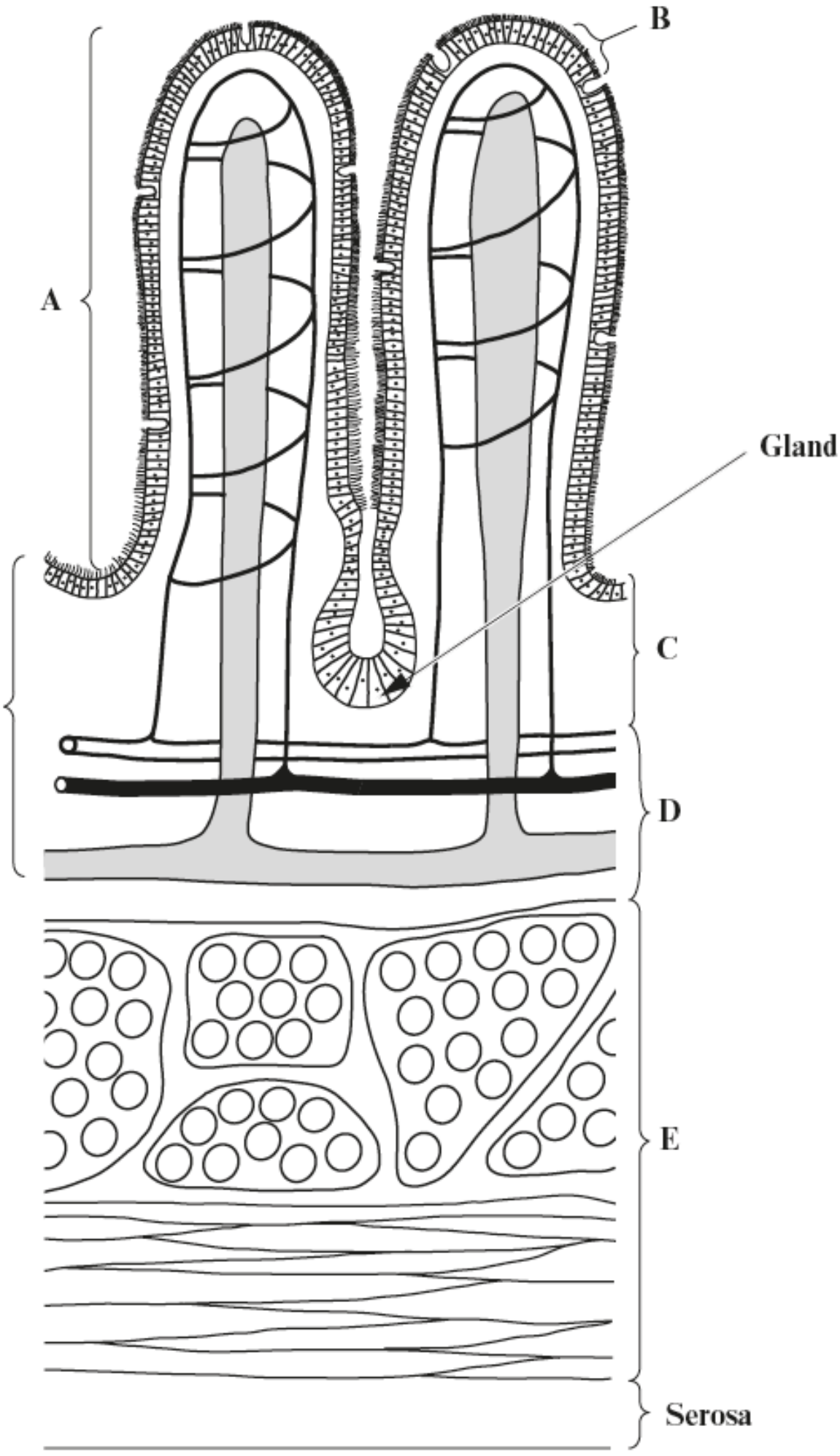
Enzyme	Name of precursor	Activated by
pepsin	pepsinogen	
trypsin	trypsinogen	

(iii) *Helicobacter pylori* is a species of bacterium that lives in the stomach and digests urea into alkaline ammonia. Ammonia is toxic to epithelial cells lining the gastric pits (glands).

Suggest how infection with *H.pylori* can lead to the development of a peptic ulcer.

[3]

16. (a) The diagram shows a longitudinal section through part of the alimentary canal.



(i) Name the part of the alimentary canal where structures A would be found.

[1]

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(ii) Name the blood vessel that transports amino acids to the liver.

[1]

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(iii) Use the diagram opposite to complete the following table.

[4]

Letter	Name	Function
B		increases surface area
C		contains glands that release secretions
D		contains vessels to transport products of digestion
E	muscle layer	

17. A study was carried out to investigate the changes to the digestive system of snakes when not fed for extended periods.

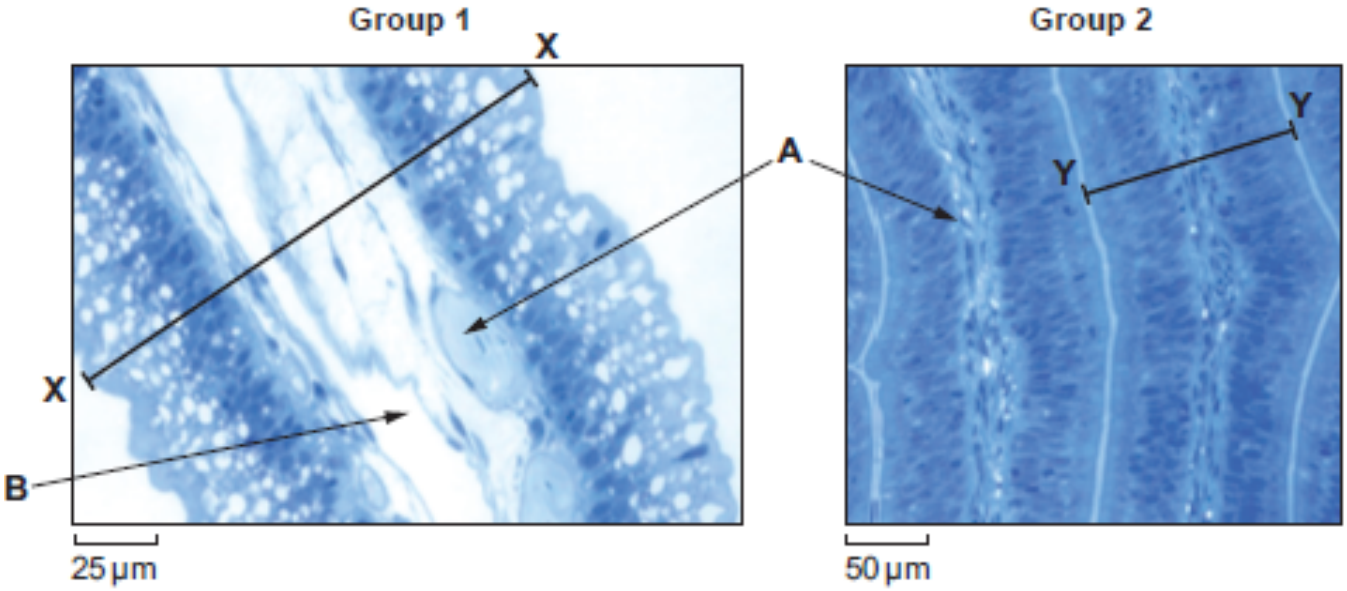
Burmese pythons *(Python molurus bivittatus)* are a species of snake that hide and wait for their prey to come close enough to catch and eat. Their prey is ingested whole and can weigh up to 25% of the snake's body mass. Digestion takes from 10 to 14 days. They can go without food for up to one year.

Two groups of snakes were fed for a four-week period as follows:

Group 1 fed every third day
Group 2 not fed during the period of the study

At the end of the study, snakes from each group were killed and the structure of the ileum examined using light and electron microscopy.

(a) The images below show sections through villi from the ileum of a snake from each group.



(i) The width of the villus shown by **X-X** in the Group **1** snake was 140 µm and the width of the villus in the Group **2** snake at **Y-Y** was 96 µm. Calculate the percentage decrease in the width of the villus when deprived of food. [2]

Percentage decrease in width = ...

(ii) Structure **A** absorbs glucose and structure **B** absorbs lipids following digestion. Name these structures. [1]

A .....

B .....

(iii) After four weeks, the following observations were made:

- structure **B** was not present in the villi of the snakes from Group **2**
- structure **A** was always present in the villi of snakes from both groups

Explain why structure **B** was not needed in Group **2** snakes whereas structure **A** was essential for all snakes. [2]

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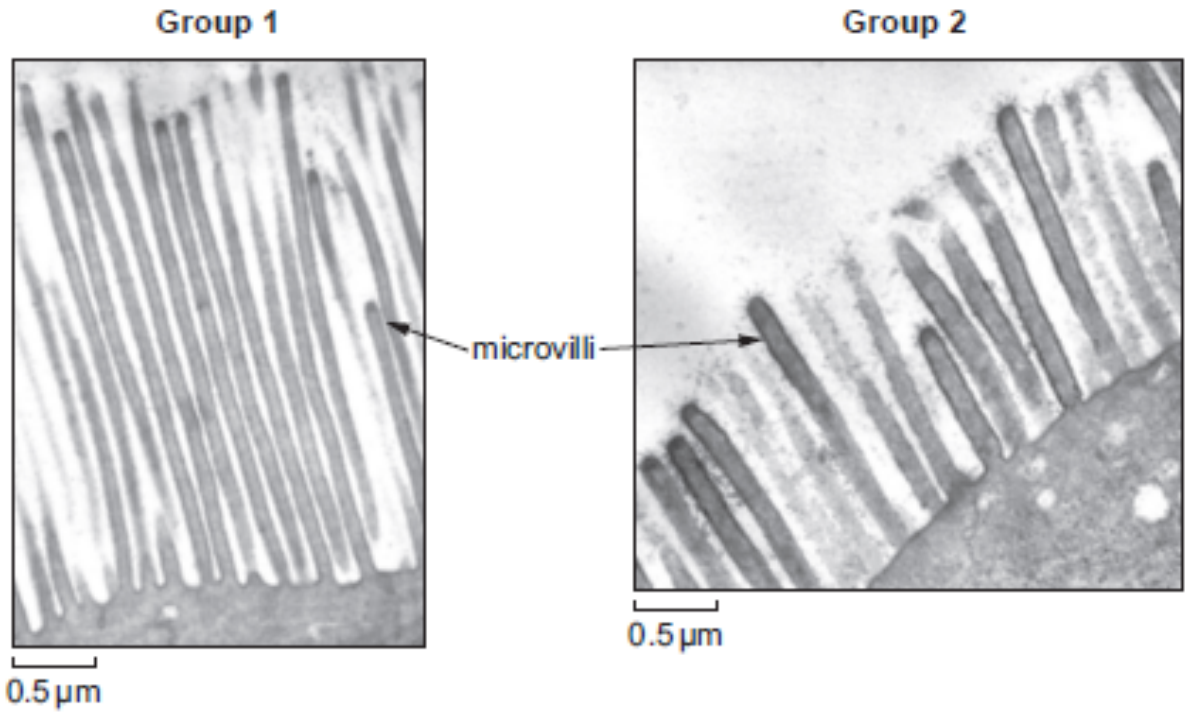
(b) The electron photomicrographs below show high magnification images of the surface of the epithelial cells covering the villi of a snake from each of Groups **1** and **2**.



Describe and explain the differences in the length and width of the microvilli seen in Group **1** compared to Group **2**. [3]

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(c) Electron microscopy also showed that the epithelial cells from the snakes in Group 1 had the following differences compared to those from Group 2.

Group 1	Group 2
large number of mitochondria	few mitochondria
cells arranged in a single layer	cells arranged in several layers

Explain the observations that were made for Group 1. [2]

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(d) Not feeding animals might be considered unethical and cruel. Explain why not feeding these snakes for four weeks would not be considered an ethical issue, but there may be other ethical issues involved with this study. [2]

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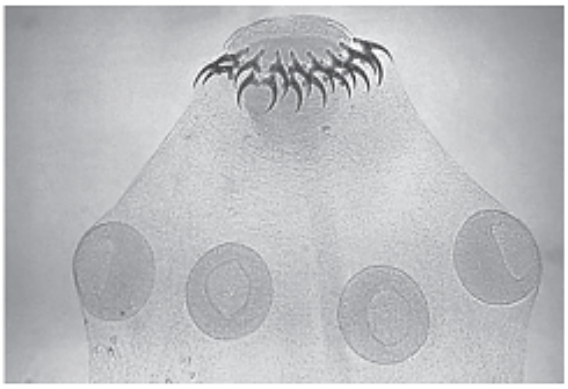
18. The table below lists various features of the human alimentary canal. Tick (✓) the boxes to show the region(s) where each feature occurs.

Feature	*Mouth*	*Stomach*	*Duodenum*	*Ileum*	*Large Intestine*
Villi present					
Site of mechanical breakdown of food					
Connects with bile duct					
Microorganisms secrete vitamins					
Carbohydrate digestion takes place					
pH 2-3					
Brunner's glands secrete alkaline fluid					
Main region of water absorption					
Protein digestion begins					

(Total 9 marks)

19. The images below show two parasites of humans. Both are specialised to survive in different environments. The head louse, *Pediculus humanus capitis*, is an **ectoparasite** while the tapeworm *Taenia solium* is an **endoparasite**.



(a) What is the difference between an **ectoparasite** and an **endoparasite**? [1]

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(b) Describe how these parasites are adapted to reduce the risk of being dislodged from their habitats. [2]

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(c) Head lice are usually transmitted by direct contact between affected people.

Describe how *Taenia solium* is transmitted. [2]

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(d) The advert below appeared in a magazine in the 1890s claiming that people could lose weight without dieting or exercising by infecting themselves with tapeworms with no ill effects.

Suggest why infecting yourself with tapeworms could lead to weight loss but also cause serious health problems. [2]

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20. *(a)* Define the term *parasite*. [2]

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(b) Name **two** characteristics of tapeworms which are adaptations to their parasitic life. [2]

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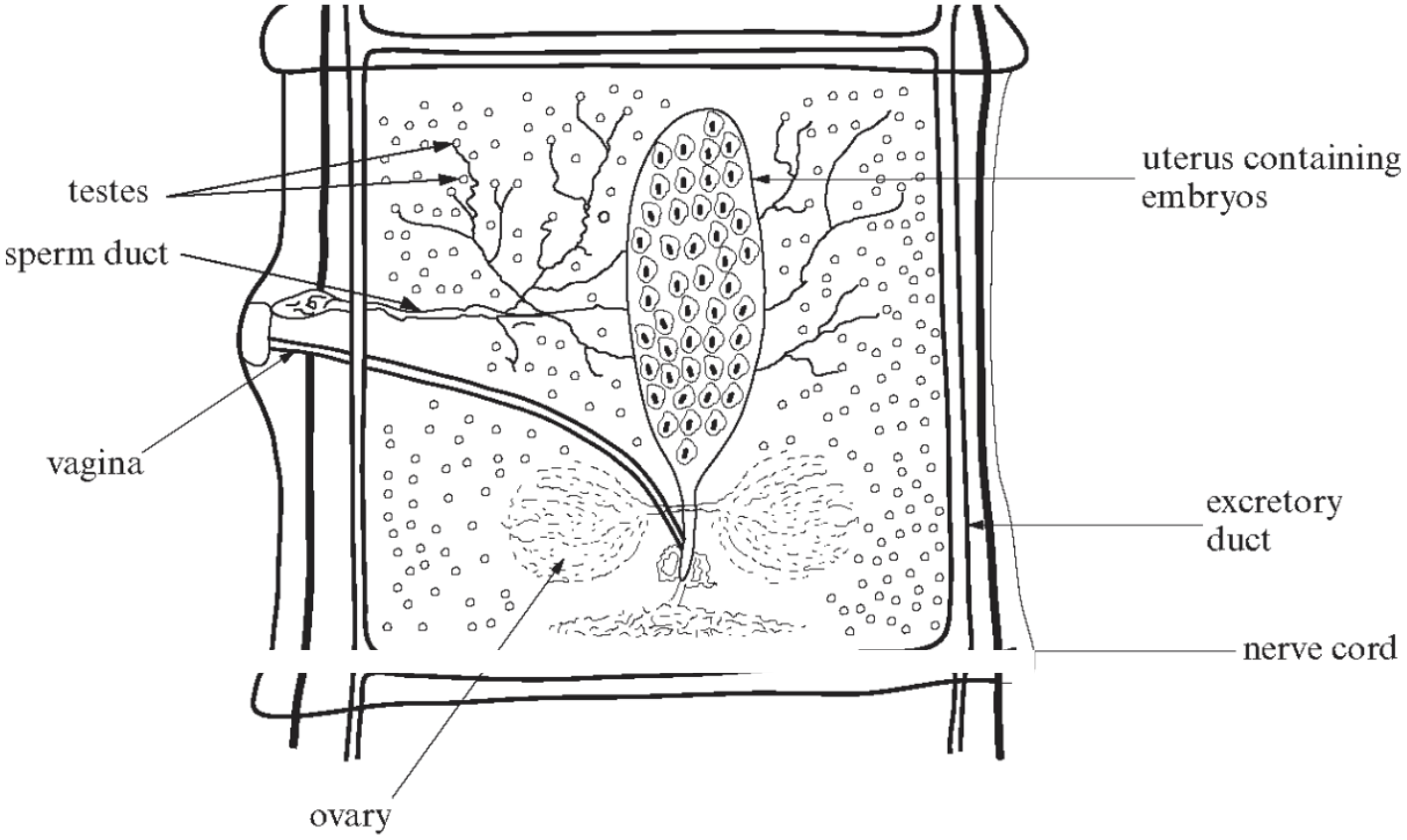
The diagram below shows one segment of a tapeworm found in the human gut. All segments in the body are identical.



(c) (i) One organ system found in almost all animals is absent from the tapeworm. By reference to the diagram, name this system. [1]

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(ii) How does the animal survive without this system? [2]

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(d) (i) Name **two** features of the worm's reproductive system, shown in the diagram, which are adaptations to its parasitic existence. [2]

1. .....

2. .....

(ii) Explain the importance of each of these features in the worm. [2]

1. .....

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2. .....

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(Total 11 marks)