**Write your name, centre number and candidate number in the boxes below.**

| Surname | Other names |
|---|---|
| | |

Centre number | | | | | |

Candidate number | | | | |

**STEM** | Exam Builder

# Human nutrition

Time allowed: 1 hour 50 minutes

**Subject code** **0610**

# Biology

## Questions from Paper 3 and Paper 4

**You must have:** a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

**/ 114**

### Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

### Information

- This paper has 10 questions worth 114 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

### Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

**1** Fig. 2.1 is a diagram of part of the human digestive system.

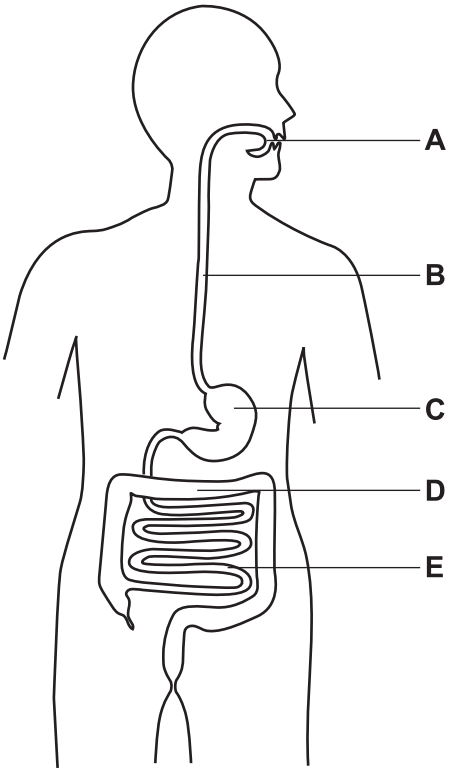



**Fig. 2.1**

**(a)** Using the information in Fig. 2.1, state the letters where:

chemical digestion of proteins begins .....

hydrochloric acid is produced .....

physical digestion of food occurs. ..... and .....

[4]

**(b)** State the names of **three** parts of the large intestine.

1 .....

2 .....

3 .....

[3]

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**(c)** Many processes occur in the digestive system.

The boxes on the left show some of the processes.

The boxes on the right show descriptions of some processes.

Draw **one** line to link each process to its description.

Draw **four** lines.

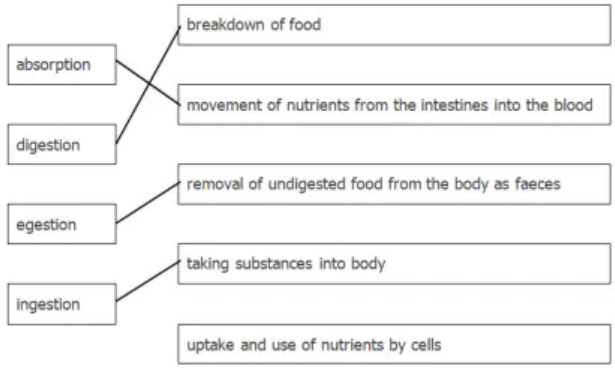
| process | description |
|---|---|
| | breakdown of food |
| absorption | |
| | movement of nutrients from the intestines into the blood |
| digestion | |
| | removal of undigested food from the body as faeces |
| egestion | |
| | taking substances into the body |
| ingestion | |
| | uptake and use of nutrients by cells |

[4]

[Total: 11]

Digestive system, teeth and digestion Click for more variations

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| | | | |
|---|---|---|---|
| 1(a) | **C** ;<br>**C** ;<br>**A** and **C** ; | **4** | either order |
| 1(b) | colon ;<br>rectum ;<br>anus ; | **3** | |
| 1(c) |  | **4** | **R** each additional line |

2 **(a)** State the meaning of the term chemical digestion.

.....

.....

.....

.....

..... [2]

**(b)** Enzymes are involved in chemical digestion.

Table 3.1 shows some information about enzymes used for chemical digestion.

**(i)** Complete Table 3.1.

**Table 3.1**

| enzyme | substrate | products |
|---|---|---|
| amylase | | simple reducing sugars |
| lipase | fats and oils | |
| protease | proteins | |

[4]

**(ii)** State where amylase, lipase and protease are made in the human body.

amylase .....

lipase .....

protease .....

[3]

**(c)** **(i)** State the name of the acid found in gastric juice.

..... [1]

**(ii)** State **two** functions of the acid found in gastric juice.

1 .....

2 .....

[2]

[Total: 12]

Digestive system, teeth and digestion Click for more variations

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<table>
<tr><td>2(a)</td><td>breakdown of large molecules to small molecules ;<br>insoluble to soluble (molecules) ;</td><td>2</td><td></td></tr>
<tr><td>2(b)(i)</td><td>
<table>
<tr><th>enzyme</th><th>substrate</th><th>products</th></tr>
<tr><td>amylase</td><td>starch ;</td><td>simple reducing sugars</td></tr>
<tr><td>lipase</td><td>fats and oils</td><td>fatty acids ;<br>glycerol ;</td></tr>
<tr><td>protease</td><td>proteins</td><td>amino acids ;</td></tr>
</table>
</td><td>4</td><td></td></tr>
<tr><td>2(b)(ii)</td><td>amylase: pancreas / salivary gland ;<br>lipase: pancreas ;<br>protease: pancreas / stomach ;</td><td>3</td><td></td></tr>
<tr><td>2(c)(i)</td><td>hydrochloric ;</td><td>1</td><td></td></tr>
<tr><td>2(c)(ii)</td><td>killing (named), harmful microorganisms / pathogens (in food) ;<br>providing, an acidic / correct / optimum, pH for enzymes ;</td><td>2</td><td></td></tr>
</table>

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**3** **(a)** A balanced diet includes foods that contain calcium ions.

**(i)** (Circle) the food that has the highest calcium content.

**cheese** **egg** **orange** **potato**

[1]

**(ii)** Table 4.1 shows the recommended calcium intake for different age groups.

**Table 4.1**

| age group in years | recommended calcium intake / mg per day |
|---|---|
| 0–3 | 500 |
| 4–8 | 800 |
| 9–18 | 1300 |
| 19–50 | 1000 |
| 51+ | 1200 |

The list shows five statements about the data in Table 4.1.

Tick (✓) **two** statements that are correct descriptions of the data shown in Table 4.1.

| | |
|---|---|
| Age group 51+ has the highest recommended daily intake of calcium. | |
| As age increases, the recommended daily intake of calcium decreases. | |
| As age increases, the recommended daily intake of calcium increases, then decreases and then increases again. | |
| The recommended daily intake of calcium doubles from ages 0–3 to ages 19–50. | |
| The recommended daily intake of calcium is higher at ages 19–50 than at ages 9–18. | |

[2]

**(iii)** Suggest reasons why some age groups need more calcium in their diet than others.

.....

.....

.....

.....

..... [2]

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**(b)** Some diseases are caused by an unbalanced diet.

The boxes on the left contain the names of two diseases.

The boxes on the right contain some sentence endings.

Draw **one** straight line from each box on the left to a box on the right to make **two** correct sentences.

| | |
|---|---|
| | is caused by a lack of carbohydrate. |
| Rickets | |
| | is caused by a lack of iron. |
| | is caused by a lack of vitamin C. |
| Scurvy | |
| | is caused by a lack of vitamin D. |

[2]

**(c)** **(i)** State **one** dietary source of fibre.

..... [1]

**(ii)** Describe the importance of fibre in the diet.

.....

.....

..... [1]

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**(d)** Fig. 4.1 is a diagram of part of the digestive system.

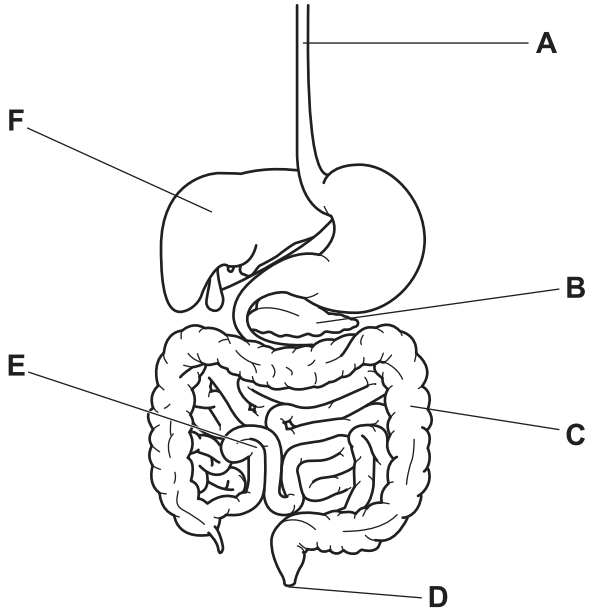



**Fig. 4.1**

**(i)** State **one** letter, from Fig. 4.1, that labels the part of the digestive system where egestion occurs.

..... [1]

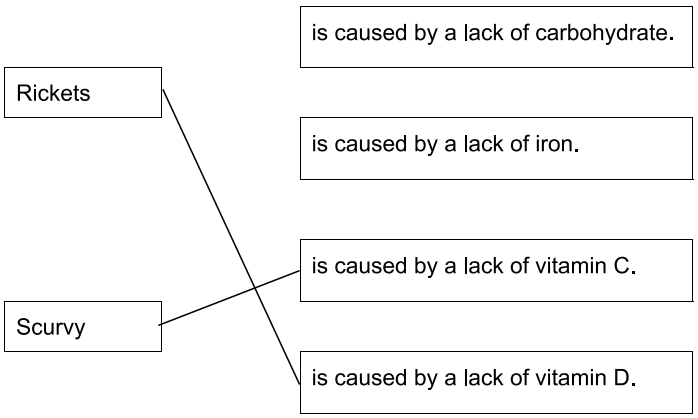
**(ii)** State the **two** letters from Fig. 4.1 that label the parts of the digestive system where water is absorbed.

..... and ..... [2]

[Total: 12]

Diet Click for more variations

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| | | | |
|---|---|---|---|
| **3**(a)(i) | cheese ; | **1** | **R** each additional circle |
| **3**(a)(ii) | As age increases the recommended daily intake of calcium increases, then decreases and then increases again. ;<br>The recommended daily intake of calcium doubles from ages 0–3 to ages 19–50. ; | **2** | 3rd box and 4th box from top<br>**R** each additional tick |
| **3**(a)(iii) | calcium is needed for (strong) bones / teeth ;<br>(more) calcium is needed, when growing / for development / pregnancy / preventing rickets / prevents osteoporosis / maintaining bone density / AW ; | **2** | |
| **3**(b) |  ;; | **2** | one mark for each correct line<br>**R** each additional line |
| **3**(c)(i) | (named) fruit / (named) vegetables / (named) nuts / (named) seeds / (named) wholegrain products ; | **1** | |
| **3**(c)(ii) | regular bowel movements / prevents constipation / bulking up, stools or faeces / correct ref. to peristalsis (described) / AVP ; | **1** | |

| | | | |
|---|---|---|---|
| **3**(d)(i) | **D** ; | **1** | |
| **3**(d)(ii) | **C** ;<br>**E** ; | **2** | either order |

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**4** **(a)** The boxes on the left show the types of digestion.

The boxes on the right contain sentence endings.

Draw lines to make **four** correct sentences.

| type of digestion | sentence ending |
| --- | --- |
| | breaks down food into smaller pieces. |
| Chemical digestion | breaks down food molecules. |
| | involves chemical changes. |
| Physical digestion | involves enzymes. |

[4]

**(b)** Ingestion occurs in the mouth.

State the name of the part of the alimentary canal where egestion occurs.

..... [1]

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**(c)** Fig. 7.1 shows a section through a human tooth.

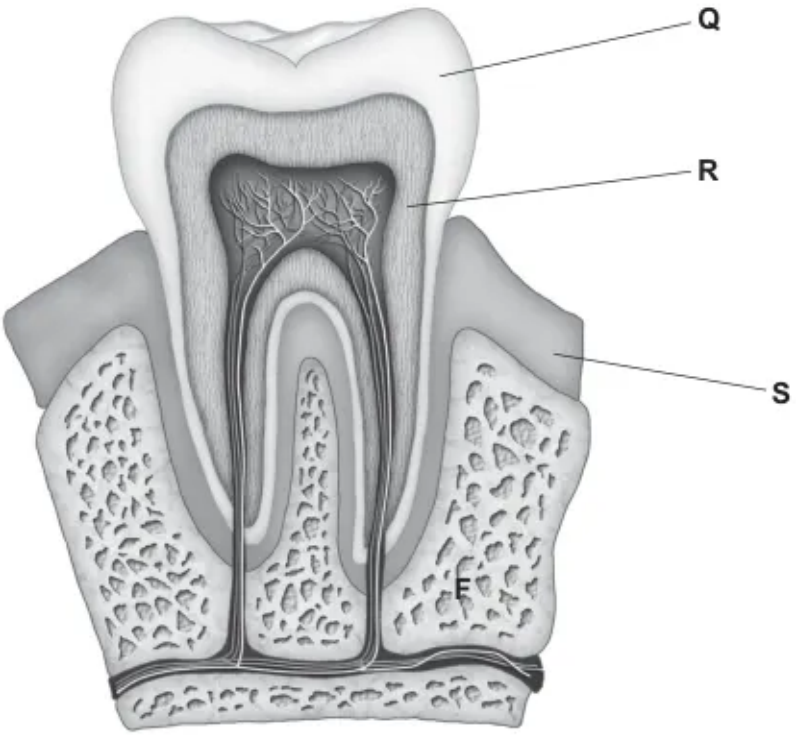



**Fig. 7.1**

**(i)** State the names of structures **Q**, **R** and **S** in Fig. 7.1.

**Q** .....

**R** .....

**S** .....

[3]

**(ii)** State the names of **two** structures found inside the pulp.

1 .....

2 .....

[2]

**(iii)** Identify the type of tooth shown in Fig. 7.1.

Explain how you made your choice.

type .....

explanation .....

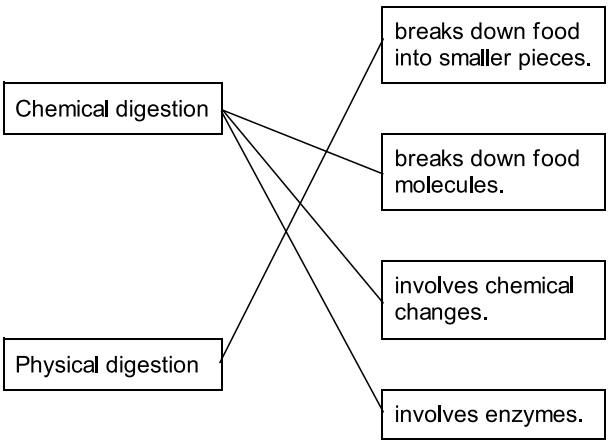
.....

.....

[2]

[Total: 12]

Digestive system, teeth and digestion Click for more variations

| | | | |
|---|---|---|---|
| 4(a) |  | 4 | **R** each additional line |
| 4(b) | anus ; | 1 | |
| 4(c)(i) | **Q** enamel ;<br>**R** dentine ;<br>**S** gum ; | 3 | |
| 4(c)(ii) | nerves / neurones / nerve cell / receptors ;<br>blood vessels ; | 2 | |
| 4(c)(iii) | molar ;<br>*any one from:*<br>flat top / grinding surface / large surface ;<br>multiple roots ; | 2 | |

**5** Complete the sentences about enzymes by writing a suitable word or phrase in each of the spaces provided.

Enzymes are involved in chemical digestion which produces small ..... molecules that can be absorbed into the blood.

Two examples of protease enzymes are pepsin and trypsin. Pepsin is produced by the ..... and requires acidic conditions. These conditions are created by the release of ..... , which provides the optimum pH for pepsin activity and also kills harmful ..... .

The ..... produces trypsin which breaks down protein in ..... pH conditions. These conditions are created by a substance called ..... , which neutralises the gastric juices and also has an important role in the ..... of fats and oils.

[8]

Digestive system, teeth and digestion Click for more variations

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| | | | |
|---|---|---|---|
| **5** | soluble ;<br>stomach ;<br>hydrochloric acid ;<br>(named) microorganisms / pathogens ;<br>pancreas / small intestine ;<br>alkaline ;<br>bile / bile salts ;<br>emulsification ; | **8** | |

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**6** Digestive enzymes catalyse the breakdown of large insoluble molecules.

**(a) (i)** Explain why it is important that large insoluble molecules are broken down by chemical digestion.

.....

.....

.....

.....

..... [2]

**(ii)** State the name of the substance that is the solvent for most molecules that have been digested by enzymes.

..... [1]

**(b)** The activity of two protease enzymes, **A** and **B**, was measured at different pHs. Both enzymes are found in the human alimentary canal.

The results are shown in Fig. 2.1.

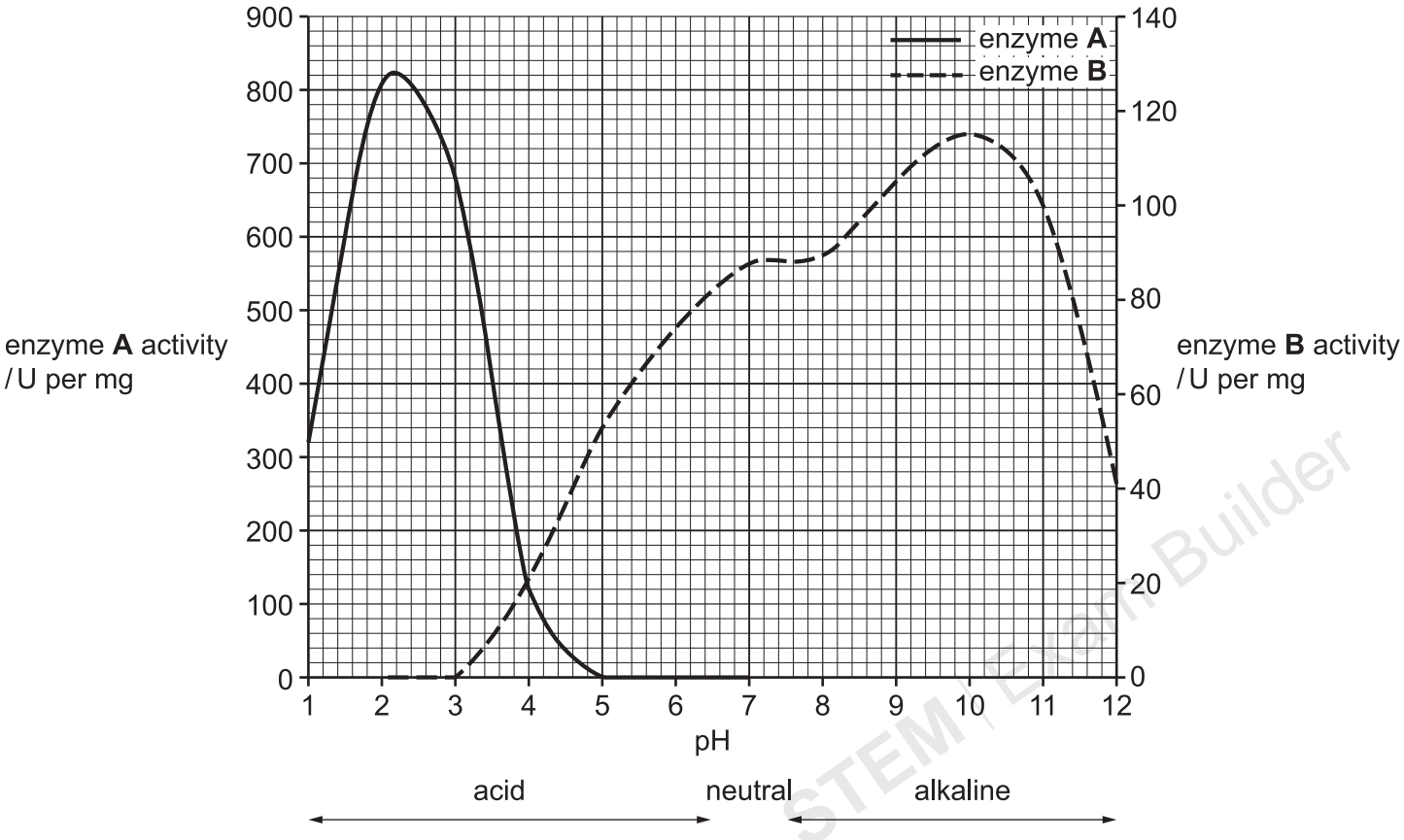



**Fig. 2.1**

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Describe **and** explain the roles of the two protease enzymes, **A** and **B**, in the alimentary canal.

Use the information in Fig. 2.1 to support your answer.

.....

.....

.....

.....

.....

.....

.....

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.....

.....

.....

.....

..... [6]

**(c)** Maltase is a digestive enzyme that acts in the small intestine.

State the exact location of maltase in the small intestine.

..... [1]

[Total: 10]

Digestive system, teeth and digestion Click for more variations

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| | | | |
|---|---|---|---|
| **6**(a)(i) | *any two from:*<br>become soluble **;**<br>for absorption **;**<br>small enough, for diffusion / active transport **;** | **2** | |
| **6**(a)(ii) | water **;** | **1** | |
| **6**(b) | *any six from:*<br>**1** protein → amino acids **;**<br><br>**2** ref to specificity **;**<br>**3** both enzymes are active between pH 3 and pH5 **;** **A** at pH4<br><br>**4** **A** is pepsin **;**<br>**5** optimum pH at 2 **;**<br>**6** enzyme shows, no activity / is denatured, from pH 5 **;**<br>**7** (functions) in stomach **;**<br>**8** where HCl is present / in acid conditions **;**<br><br>**9** **B** is trypsin **;**<br>**10** optimum pH at 10 **;**<br>**11** enzyme shows, no activity / is denatured, from pH 3 **;**<br>**12** (functions) in small intestine / secreted from pancreas **;**<br>**13** bile neutralises (stomach) acid / in alkaline conditions **;** | **6** | MP1 **A** breaks down proteins (to, polypeptides / peptides)<br><br>MP13 **A** pancreatic juice neutralises stomach acid |
| **6**(c) | (membrane of) epithelium **;** | **1** | |

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7 A student investigated the digestion of starch.

Fig. 2.1 shows the apparatus she used.

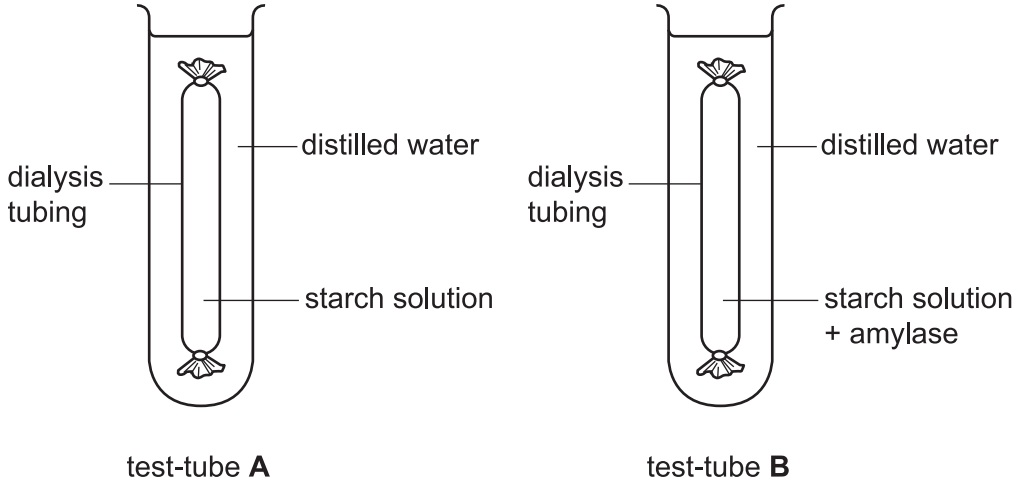



**Fig. 2.1**

Dialysis tubing is used to represent a cell membrane.

The dialysis tubing material allows small molecules to move across it, but not larger molecules.

Test-tubes **A** and **B** were set up as shown in Fig. 2.1 and placed in a water-bath at 37 °C for 30 minutes.

The liquid outside the dialysis tubing in test-tubes **A** and **B** was tested with Benedict's solution at 0 minutes and after 30 minutes.

Table 2.1 shows the results.

**Table 2.1**

| test-tube | colour with Benedict's solution at 0 minutes | colour with Benedict's solution at 30 minutes |
|---|---|---|
| **A** | blue | blue |
| **B** | blue | red |

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**(a)** Using the information in Fig. 2.1 and Table 2.1, explain the reasons for the difference in the results for test-tubes **A** and **B** in Table 2.1.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

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**(b)** Complete Table 2.2 by writing in the names of the missing enzymes, substrates and products.

**Table 2.2**

| enzyme | substrate | product or products |
|---|---|---|
| pepsin | | |
| | | fatty acids and glycerol |
| trypsin | | |
| | | glucose |

[4]

**(c)** State the name of the structures that increase the surface area for absorption in the small intestine.

..... [1]

[Total: 11]

Digestive system, teeth and digestion Click for more variations

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| | | | |
|---|---|---|---|
| 7(a) | **1** Benedict's solution in A, remains blue / no colour change / negative result, as there is no, maltose / breakdown of starch **;**<br>**2** Benedict's solution in B, turns red / changes colour / positive result, in the presence of maltose **;**<br>**3** amylase breaks down starch **;**<br>**4** into maltose **;**<br>**5** (maltose) is a small / soluble, molecule **;**<br>**6** maltose is able to pass through the dialysis tubing **;**<br>**7** by diffusion **;**<br>**8** from an area of high concentration to low concentration / down a concentration gradient **;** | **6** | |
| 7(b) | pepsin / protein / amino acids / peptides<br>lipase / fats / oils / lipids / fatty acid and glycerol<br>trypsin / protein / amino acids / peptides<br>maltase / maltose / glucose<br>**;;;;** | **4** | one mark for each correct row |
| 7(c) | villi / microvilli **;** | **1** | |

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**8** **(a)** The reactions of chemical digestion are catalysed by enzymes.

Fig. 1.1 shows the stages of an enzyme-catalysed reaction.

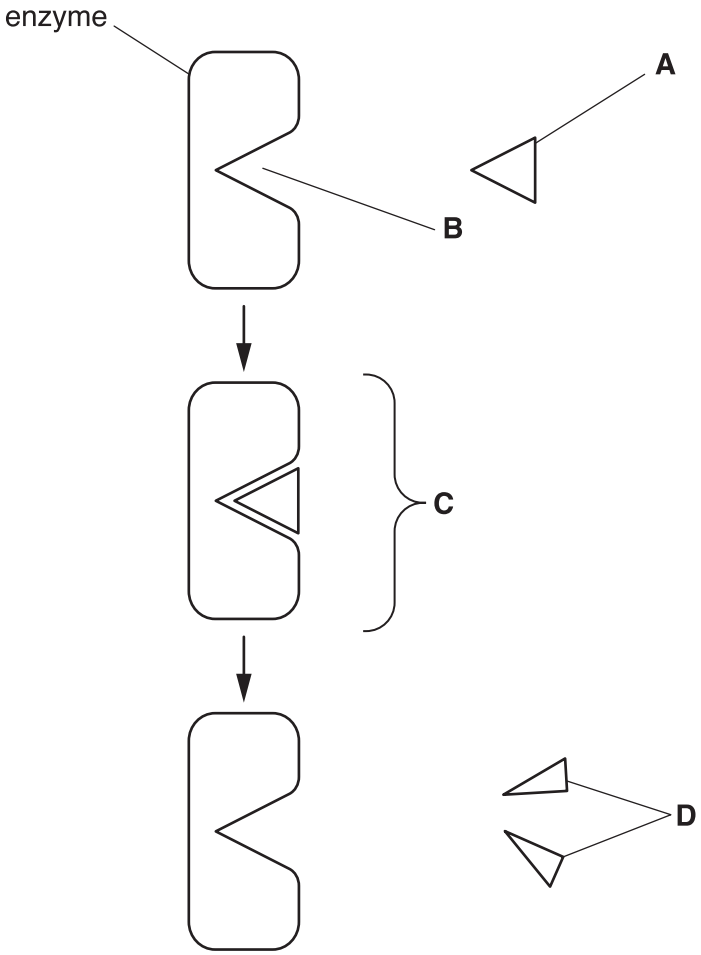



**Fig. 1.1**

State the names of **A** to **D** in Fig. 1.1.

**A** .....

**B** .....

**C** .....

**D** .....

[4]

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**(b)** Explain the importance of chemical digestion.

.....

.....

.....

.....

.....

.....[2]

**(c)** Fig. 1.2 shows the human alimentary canal and associated organs.

The functions of some of these parts of the body are given in Table 1.1.

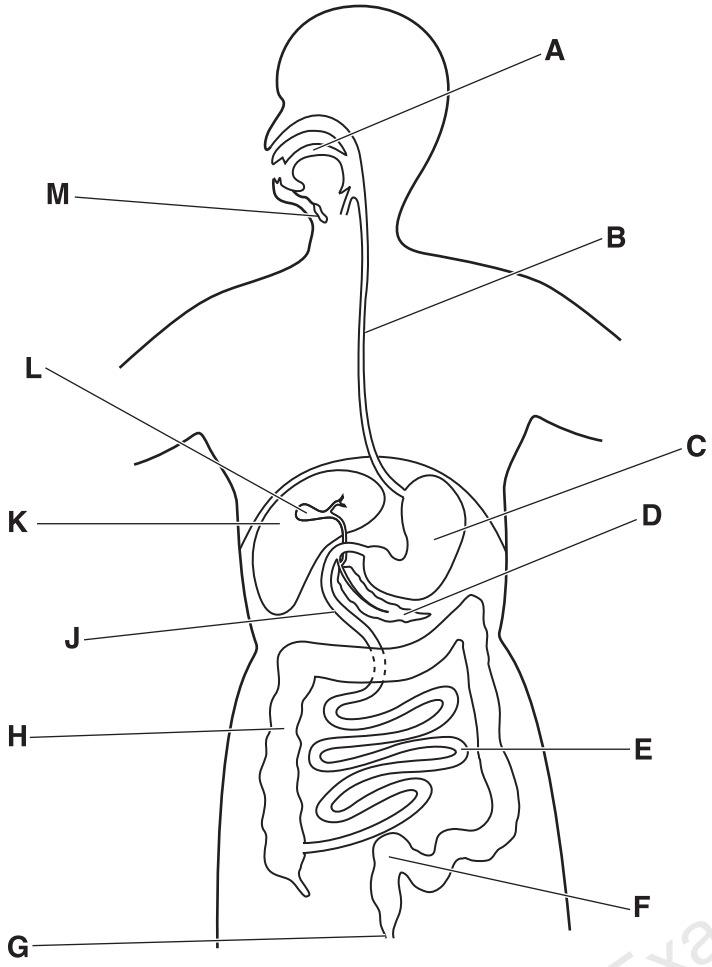



**Fig. 1.2**

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Complete Table 1.1. One row has been done for you.

**Table 1.1**

| function | letter from Fig. 1.2 | name of structure |
|---|---|---|
| site of starch digestion | | |
| reabsorption of water | | |
| secretion of pepsin | | |
| site of maltose digestion | | |
| secretion of bile | | |
| storage of faeces | **F** | rectum |
| secretion of lipase and trypsin | | |

[6]

[Total: 12]

Digestive system, teeth and digestion Click for more variations

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| | | | |
|---|---|---|---|
| **8**(a) | **A** substrate **;**<br>**B** active site **;**<br>**C** enzyme-substrate complex **;**<br>**D** product(s) **;** | **4** | |
| **8**(b) | production of, small(er) / soluble / simple(r), <u>molecules</u> **;**<br><br>(small molecules can be) absorbed / ref**.** to absorption **; ora**<br><br>(moves through) cell membranes / wall of intestine / into blood / into cells **;** | **2** | |
| **8**(c) | <table><tr><th>function</th><th>letter from Fig. 2.1</th><th>name of structure</th></tr><tr><td>site of starch digestion</td><td>**A**<br>**J / E**</td><td>mouth / buccal cavity<br>small intestine</td></tr><tr><td>reabsorption of water</td><td>**J / E**<br>**H**<br>**F**</td><td>small intestine<br>colon / large intestine<br>rectum</td></tr><tr><td>secretion of pepsin</td><td>**C**</td><td>stomach</td></tr><tr><td>site of maltose digestion</td><td>**J / E**</td><td>small intestine</td></tr><tr><td>secretion of bile</td><td>**K**<br>**L**</td><td>liver<br>gall bladder</td></tr><tr><td>storage of faeces</td><td>**F**</td><td>rectum</td></tr><tr><td>secretion of lipase and trypsin</td><td>**D**</td><td>pancreas</td></tr></table> **;;;;;;** | **6** | *one mark per row*<br>*the letter must agree with the name*<br>*if more than one letter or name mark first one only*<br><br>**A J/E** small intestine |

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**9** **(a)** Fig. 4.1 is a diagram of the alimentary canal.

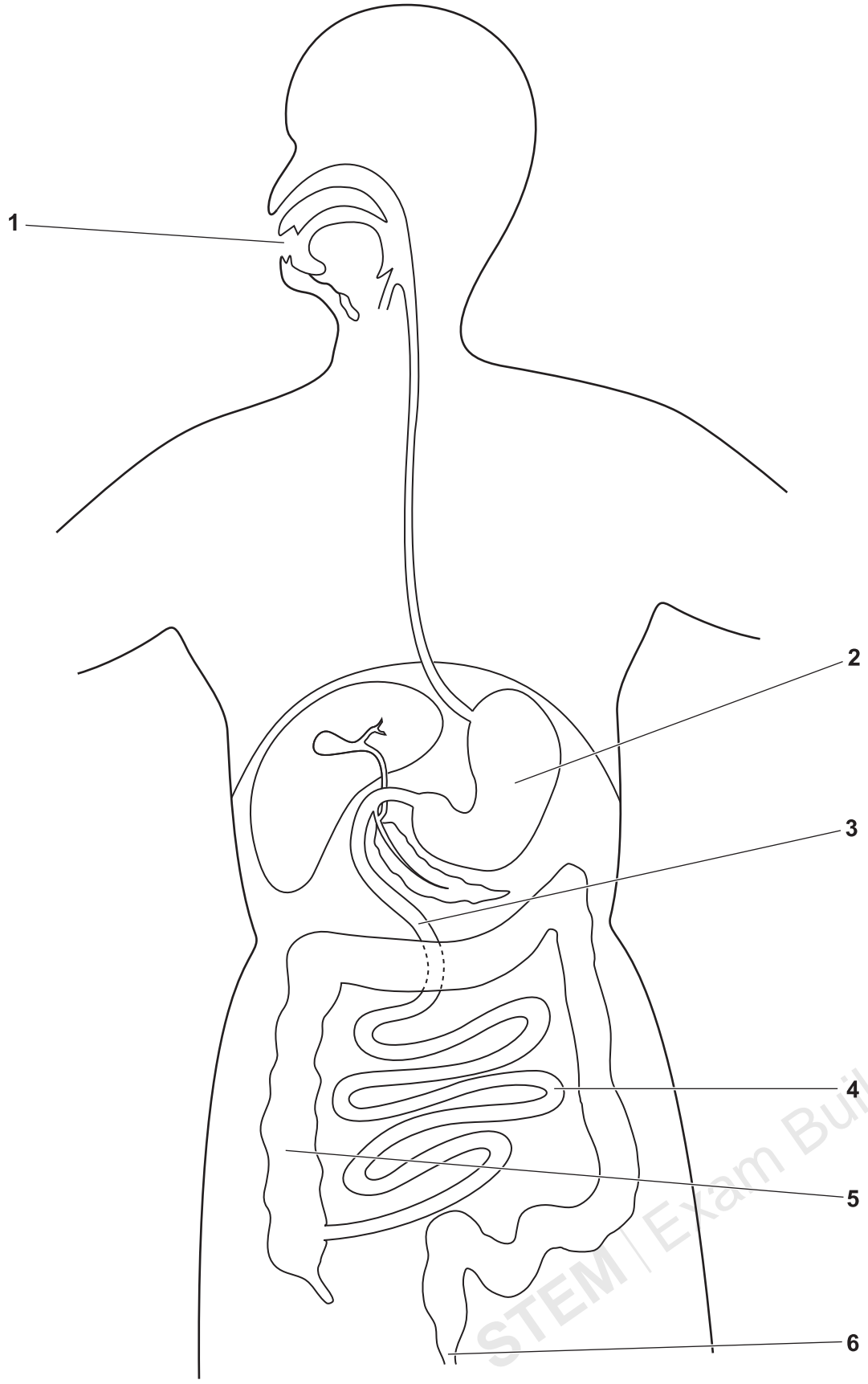



**Fig. 4.1**

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Complete Table 4.1 by stating:

- the names of the organs from Fig. 4.1
- the letters of **all** the processes shown in the key that occur in each organ.

Key:
**A –** absorption
**C –** chemical digestion
**E –** egestion
**I –** ingestion
**M –** mechanical digestion

**Table 4.1**

| number from Fig. 4.1 | name of the organ | letter or letters of all the processes that occur in the organ |
|---|---|---|
| **1** | | |
| **2** | | |
| **3** | | |
| **4** | | |
| **5** | | |
| **6** | | |

[6]

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**(b)** Fig. 4.2 is a diagram of a villus. The arrow indicates the direction of blood flow.

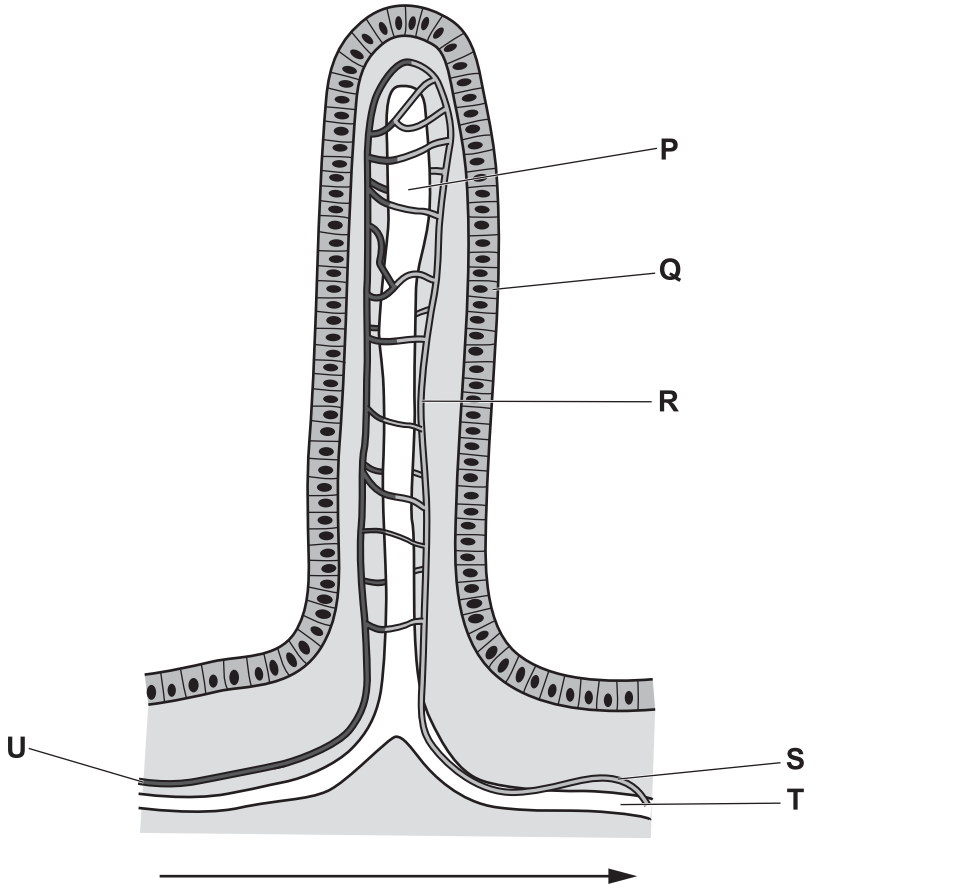



**Fig. 4.2**

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Describe the structure of a villus **and** its role in the alimentary canal.

Use the letters in Fig. 4.2 to support your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

[Total: 12]

Absorption and villi Click for more variations

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**9**(a)

| number from Fig. 4.1 | name of the organ | letter or letters of all the processes that occur in the organ |
|---|---|---|
| **1** | mouth | **I**, **C**, **M** |
| **2** | stomach | **C**, **M** (**A**) |
| **3** | duodenum | **A**, **C** (**M**) |
| **4** | ileum | **A**, **C** |
| **5** | colon | **A** |
| **6** | anus | **E** |

;;;;;;

**6** one mark for each correct row

**9**(b)

*any six from:*
1 **P** is a lacteal **;**
2 (lacteals) absorb, fats / fatty acids / glycerol / (named) fat soluble vitamin **;**
3 **T** / lymphatic vessel, returns lymph / fats, to blood / to circulatory system **;**
4 **Q** / epithelial cell, **has** microvilli **;**
5 (microvilli / villi) increase the surface area for absorption **;**
6 **Q** is one cell thick for short diffusion distance / fast diffusion
7 **Q** is site of breakdown of maltose to glucose **;**
8 glucose uptake by active transport **;**
9 **R** / capillary, for absorption of, amino acids / glucose / salts / water / products of digestion / soluble nutrients **;**
10 **R** has thin walls / **R** is one cell thick **;**
11 blood flowing to maintain concentration gradient / AW **;**
12 transports absorbed nutrients to, **S** / venule / vein **;**

**6**

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**10** The length of the small intestine was measured in four types of mammal.
The results are shown in Table 3.1.

**Table 3.1**

| mammal | length of small intestine / cm | length of small intestine relative to body mass / cm per g |
|---|---|---|
| insect-eating bat | 19 | 2.30 |
| domestic cat | 104 | 0.05 |
| rat | 98 | 0.34 |
| human | 552 | 0.01 |

**(a)** Use the information in Table 3.1 to compare the length of the small intestine of the four mammals.

.....

.....

.....

.....

.....

.....

.....[3]

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**(b)** Fig. 3.1 is a diagram showing a short length of the small intestine of a mammal.

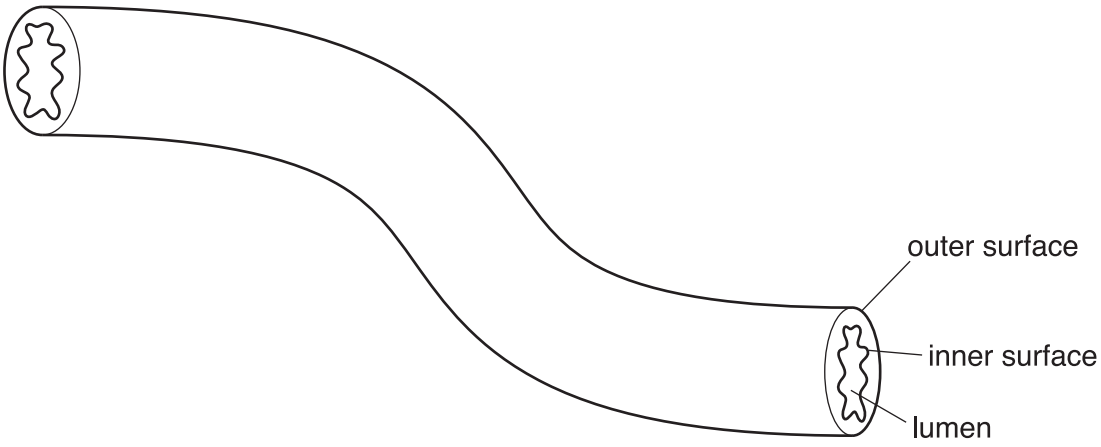



**Fig. 3.1**

A function of the small intestine is absorption.

Describe how a molecule of glucose passes from the lumen of the small intestine into the blood.

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**(c)** Measurements were taken of the inner and outer surface area of two parts of the small intestine for the four mammals in Table 3.1. The results are shown in Table 3.2.

**Table 3.2**

| mammal | ratio of inner surface area to outer surface area | |
|---|---|---|
| | duodenum | ileum |
| insect-eating bat | 283:1 | 54:1 |
| domestic cat | 15:1 | 12:1 |
| rat | 6:1 | 4:1 |
| human | 7:1 | 3:1 |

**(i)** Suggest which mammal has the most villi per centimetre of small intestine.

.....[1]

**(ii)** The duodenum is more effective than the ileum at absorption. Use the information in Table 3.2 to explain why.

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.....[3]

**(d)** Bile is released into the small intestine from the gall bladder.

Outline the roles of bile.

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.....[4]

**[Total: 14]**

Absorption and villi Click for more variations

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| | | | |
|---|---|---|---|
| **10**(a) | human / largest mammal, has the longest / bat has the shortest (small intestine);<br>(small intestine of) rat and cat are very similar in length;<br>comparative data, quote / calculation with units at least once;<br>negative correlation between length and length relative to body mass; | **3** | **A** relative to body mass bat much larger than other three animals / smallest length relative to body mass is in humans |
| **10**(b) | movement into / out of / through, (epithelial) cells / villi;<br>into, capillaries;<br>across cell membranes;<br>by active transport;<br>through protein carriers;<br>against a concentration gradient;<br>using energy; | **3** | **I** walls<br>**I** into blood |
| **10**(c)(i) | (insect-eating) bat; | **1** | |
| **10**(c)(ii) | ratios are higher in the duodenum;<br>higher (inner) surface area (than ileum);<br>data comparison (for any one animal);<br>more villi;<br>more microvilli; | **3** | |
| **10**(d) | emulsification;<br>increased surface area of fat (globules);<br>faster, digestion / break down (of fat by enzymes);<br>by lipase / to fatty acids and glycerol;<br>neutralises (stomach) acid / chyme;<br>provides alkaline medium for, pancreatic enzymes / lipase;<br>denatures, pepsin / stomach, enzymes;<br>AVP; | **4** | **I** faster break down of fats unqualified |
| | | **Total: 14** | |

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