Helicate

HELICATE · AS AND A-LEVEL BIOLOGY · TOPIC BANK

3.3.3 Digestion and absorption

Topic question bank

Version 1 · 9 October 2026

Name

Date

QUESTIONS	TOTAL MARKS	TIME	YOUR SCORE
7	59	No time limit	/ 59

Contents

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Total		**59**

Instructions

- Answer the questions in the spaces provided. Show all your working.
- The marks for each question are shown in brackets. Use them to judge how much detail to give.
- Work through a subtopic at a time, then mark your answers with the matching mark scheme.

Original questions by Helicate for AQA AS and A-level Biology (7401/7402), specification section 3.3.3. Not affiliated with or endorsed by AQA.

Do not write outside the box

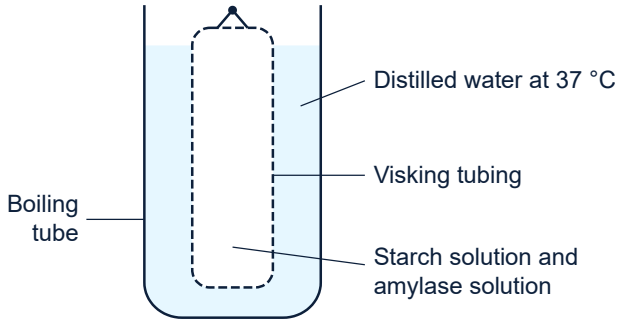
Digestion of carbohydrates 3.3.3

Visking tubing is a partially permeable membrane. Its pores let small molecules pass through, but not large molecules. A student used Visking tubing as a model of digestion and absorption in the gut.

The student:

- tied one end of a length of Visking tubing
- put 10 cm^3 of starch solution and 2 cm^3 of amylase solution into the tubing and tied the other end
- placed the tubing in a boiling tube containing 30 cm^3 of distilled water at 37 °C, as shown in Figure 1
- every 5 minutes, removed a small sample of the water outside the tubing and measured its concentration of reducing sugar, using Benedict's reagent and a colorimeter.

Figure 1



0 1 . 1 After 60 minutes, the water outside the tubing contained reducing sugar but no starch.
Explain why.

[3 marks]

Question 1 continues on the next page

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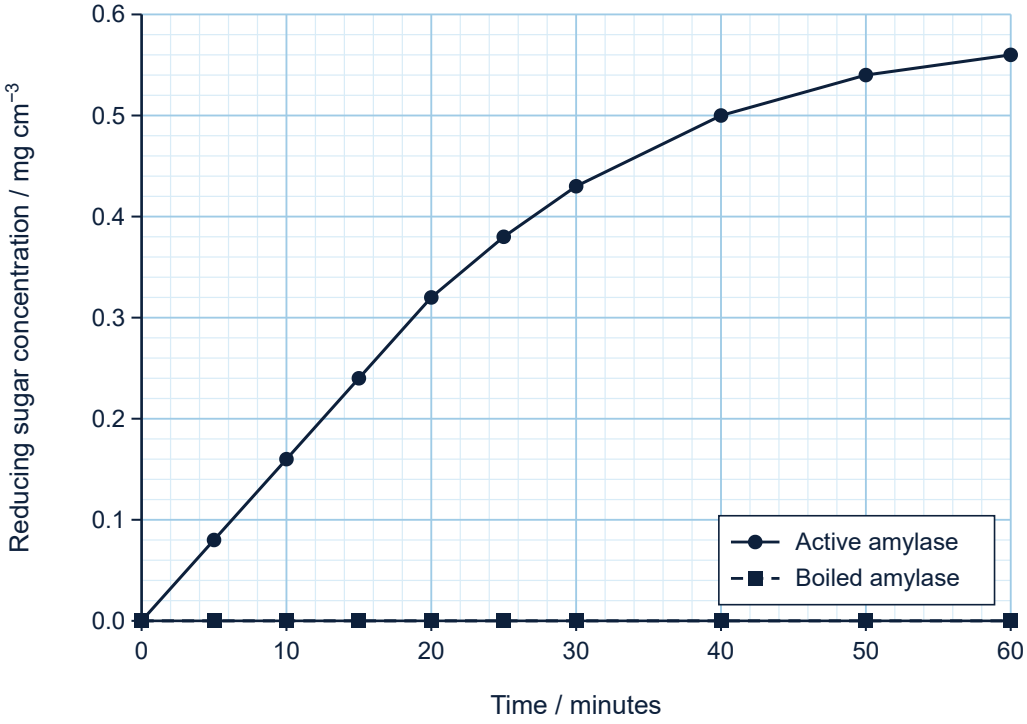
The student set up a second boiling tube in the same way, but used amylase solution that had been boiled and then cooled.

Figure 2 shows the results.

Figure 2



0 1 . 2 Use Figure 2 to calculate the rate of increase in the concentration of reducing sugar outside the tubing with active amylase during the first 20 minutes.
Give your answer in standard form.

[2 marks]

Answer ..... **mg cm^{-3} min^{-1}**

Question 1 continues on the next page

Do not write outside the box

0 1 . 3 Explain why the student set up the tube containing boiled amylase.

[2 marks]

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0 1 . 4 The Visking tubing model does not show everything that happens when starch is digested and its products are absorbed in the mammalian ileum.
Suggest **three** ways in which digestion and absorption in the ileum differ from this model.

[3 marks]

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0 1 . 5 Maltose is hydrolysed in the mammalian ileum by a disaccharidase.
Which statement about this disaccharidase is correct?
Tick (✓) one box.

[1 mark]

It is secreted into the lumen of the ileum and hydrolyses maltose into glucose and fructose. ☐

It is bound to the cell-surface membranes of epithelial cells and hydrolyses a peptide bond. ☐

It is bound to the cell-surface membranes of epithelial cells and hydrolyses a glycosidic bond. ☐

It is secreted into the lumen of the ileum and joins two glucose molecules in a condensation reaction. ☐

11

Turn over for the next question

Do not write outside the box

Digestion of lipids and the action of bile salts 3.3.3

Bile salts are released into the small intestine. A student investigated the effect of the concentration of bile salts on the rate at which lipase hydrolyses lipids in milk.

Phenolphthalein is an indicator. It is pink in alkaline solutions and colourless when the pH falls below 8.3.

The student:

- put 5 cm^3 of full-fat milk, 7 cm^3 of dilute sodium carbonate solution and 5 drops of phenolphthalein into a test tube; the mixture was pink
- added 1 cm^3 of bile salt solution
- placed this test tube and a test tube of lipase solution in a water bath at 35 °C for 10 minutes
- added 1 cm^3 of the lipase solution to the milk mixture, mixed it and started a stop clock
- recorded the time taken for the pink colour to disappear.

She did this three times with each concentration of bile salt solution. For 0% bile salts, she added 1 cm^3 of distilled water instead of bile salt solution.

0 2 . 1 Explain why the pink colour disappeared.

[2 marks]

Question 2 continues on the next page

Do not write outside the box

Table 1 shows the student's results.

Table 1

Concentration of bile salt solution / %	Time for pink colour to disappear / s			
	Repeat 1	Repeat 2	Repeat 3	Mean
0	412	398	405	405
0.25	300	288	294	294
0.5	218	231	217	
1.0	160	171	152	161
2.0	150	158	154	154

0 2 . 2 Calculate the mean time for 0.5% bile salt solution.

[1 mark]

Answer ..... **s**

0 2 . 3 Use Table 1 and your knowledge of bile salts to explain the effect of increasing the concentration of bile salt solution from 0% to 1.0% on the mean time.

[3 marks]

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 Suggest why increasing the concentration of bile salt solution from 1.0% to 2.0% had little effect on the mean time.

[2 marks]

0 2 . 5 Explain why the student added 1 cm^3 of distilled water to the tubes with 0% bile salts.

[1 mark]

0 2 . 6 The pink colour fades gradually, so the end point is difficult to judge.
Suggest **two** ways the student could make her timing of the end point more consistent between repeats.

[2 marks]

11

Turn over for the next question

Do not write outside the box

Digestion of proteins 3.3.3

Scientists investigated the hydrolysis of a protein by three enzymes from the mammalian gut: an endopeptidase, an exopeptidase and a dipeptidase.

They set up five tubes. Each tube contained the same volume and concentration of the protein in a buffer solution at 37 °C. All three enzymes are active at the pH of this buffer. The scientists added the enzymes shown in Table 2 and made each tube up to the same volume with buffer. After 60 minutes, they measured the concentrations of free amino acids and of dipeptides.

Table 2 shows their results.

Table 2

Tube	Enzymes added	Concentration after 60 minutes / μmol cm^{-3}	
		Amino acids	Dipeptides
1	None	0.0	0.0
2	Endopeptidase	0.1	0.4
3	Exopeptidase	1.2	0.3
4	Endopeptidase and exopeptidase	6.8	2.9
5	Endopeptidase, exopeptidase and dipeptidase	12.4	0.2

0 3 . 1 Use Table 2 to explain why the concentration of amino acids in tube 4 is greater than the total for tubes 2 and 3.

[3 marks]

Question 3 continues on the next page

Do not write outside the box

0 3 . 2 Each dipeptide that is hydrolysed produces two amino acids.
Use Table 2 to calculate the percentage of the increase in the concentration of amino acids from tube 4 to tube 5 that can be explained by the hydrolysis of dipeptides.
Give your answer to the nearest whole number.

[2 marks]

Answer _____ **%**

0 3 . 3 In the mammalian ileum, dipeptidases are bound to the cell-surface membranes of the epithelial cells.
Suggest how this helps the absorption of amino acids.

[2 marks]

0 3 . 4 Which statement describes the action of an exopeptidase?
Tick (✓) one box.

[1 mark]

- It hydrolyses peptide bonds within a polypeptide chain. ☐
- It hydrolyses peptide bonds at the ends of a polypeptide chain. ☐
- It forms peptide bonds at the ends of a polypeptide chain by condensation. ☐
- It hydrolyses glycosidic bonds at the ends of a polysaccharide chain. ☐

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Turn over for the next question

Do not write outside the box

Absorption of the products of digestion 3.3.3

Bile salts are made in the liver and released into the small intestine. In some liver diseases, much less bile salt is released than normal.

Drug L is used to help people lose body mass. It binds to lipase and inhibits it.

Scientists studied three groups of adults. For 3 days, every person ate the same diet, containing 100 g of triglycerides per day. The scientists measured the mass of lipid in each person's faeces and the percentages of this lipid that were triglycerides and fatty acids.

Table 3 shows their results.

Table 3

Group	People	Mean mass of lipid in faeces / g per day	Percentage of lipid in faeces present as	
			Triglycerides	Fatty acids
A	Healthy	5	16	84
B	Liver disease: low release of bile salts	31	36	64
C	Healthy, taking drug L	26	79	21

0 4 . 1 Other than fatty acids, name **one** product of the hydrolysis of a triglyceride by lipase.

[1 mark]

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Question 4 continues on the next page

Do not write outside the box

0 4 . 2 Calculate how many times greater the mass of fatty acids in the faeces per day is for group **B** than for group **A**.

[2 marks]

Answer .....

0 4 . 3 Use Table 3 to explain the results for group **C**.

[2 marks]

0 4 . 4 Use Table 3 and your knowledge of the roles of bile salts to explain the results for group **B**.

[5 marks]

10

Turn over for the next question

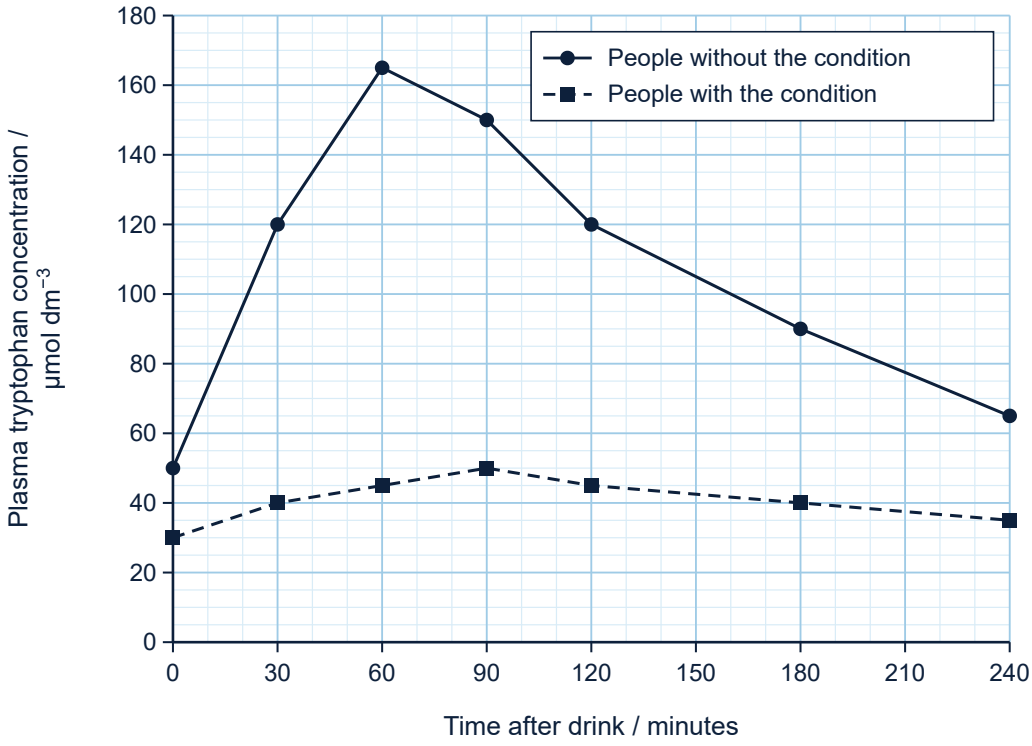
Do not write outside the box

Tryptophan is an amino acid. In the ileum, epithelial cells absorb tryptophan and several other amino acids through one type of co-transporter protein in the cell-surface membrane facing the lumen. This protein moves one sodium ion into the cell with each amino acid molecule.

In a rare inherited condition, a mutation in the gene for this protein changes its tertiary structure, so that the protein no longer transports amino acids.

Scientists gave a drink containing tryptophan to people with this condition and to people without it. The drink was given after an overnight fast. The scientists then measured the concentration of tryptophan in each person's blood plasma. Figure 3 shows their results.

Figure 3



Question 5 continues on the next page

Do not write outside the box

0 5 . 1 Use Figure 3 and your knowledge of co-transport to explain the difference between the two groups.

[4 marks]

0 5 . 2 In people with the condition, the concentration of tryptophan in the plasma still rose a little after the drink.
Suggest why.

[1 mark]

0 5 . 3 Suggest why the scientists gave the drink after an overnight fast.

[1 mark]

6

Turn over for the next question

Do not write outside the box

Some snakes eat a large meal only once every few weeks. Between meals, the microvilli in the ileum are short. After a meal, they become longer.

Scientists measured the microvilli of snakes that had not eaten for 30 days and of snakes 2 days after a meal. The number of microvilli per cell did not change. They also measured the rate of amino acid absorption by pieces of ileum placed in the same amino acid solution. Table 4 shows their results.

Table 4

Measurement	Snakes that had not eaten for 30 days	Snakes 2 days after a meal
Mean length of microvilli / μm	0.70	2.50
Mean diameter of microvilli / μm	0.12	0.12
Rate of amino acid absorption / nmol min^{-1} per cm of ileum	0.8	5.6

Treat each microvillus as a cylinder with one closed end. Its surface area is the area of its curved side plus the area of its closed end:

- area of curved side = 2 × π × radius × length
- area of closed end = π × $radius^2$

0 6 . 1 Use Table 4 to calculate how many times greater the surface area of one microvillus is 2 days after a meal than after 30 days without food.
Use π = 3.14. Give your answer to **two** significant figures.

[2 marks]

Answer .....

Question 6 continues on the next page

Do not write outside the box

0 6 . 2 Explain how the longer microvilli could increase the rate of absorption of amino acids after a meal.

[2 marks]

0 6 . 3 A student concluded that the increase in the rate of amino acid absorption after a meal was caused only by the increase in the surface area of the microvilli.
Use Table 4 and your answer to 06.1 to evaluate this conclusion.

[2 marks]

0 6 . 4 Which statement describes microvilli?
Tick (✓) one box.

[1 mark]

- Finger-like projections of the wall of the ileum, each made of many cells ☐
- Hair-like structures that beat to move food along the ileum ☐
- Folds of the inner membrane of a mitochondrion ☐
- Folds of the cell-surface membrane of an epithelial cell ☐

7

Turn over for the next question

Do not write outside the box

Extended response: digestion of starch and protein 3.3.3

0 7 A meal contains starch and protein.
Describe how enzymes in the mammalian gut hydrolyse the starch and the protein into molecules that can be absorbed by the epithelial cells of the ileum.

[6 marks]

6

END OF QUESTIONS

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