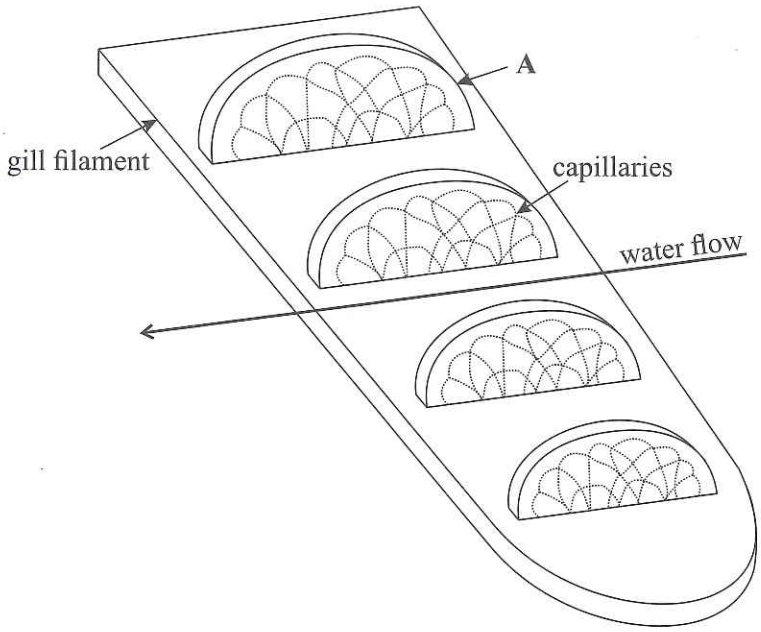
Exchange and Transport Systems — 1

If you read 'Exchange and Transport Systems' and got excited about answering questions on the rail network, prepare to be disappointed. If you read 'Exchange and Transport Systems' and got excited about answering questions on how gases are exchanged in fish, insects, plants and humans... well, it's your lucky day.

1 **Figure 1** shows a gill filament of a fish.

Figure 1



1.1 Name structure **A** on **Figure 1.**

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(1 mark)

1.2 Draw an arrow on structure **A** to show the direction of blood flow.

(1 mark)

1.3 Label structure **A** to show where the highest and lowest concentrations of oxygen are found in the blood.

(1 mark)

1.4 Explain **one** way in which the structure of the gill filament is adapted to its function.

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(2 marks)

2 A student dissected a grasshopper. As part of the dissection, she removed a piece of the grasshopper's exoskeleton.

2.1 Suggest a tool that the student could have used to cut through the exoskeleton.

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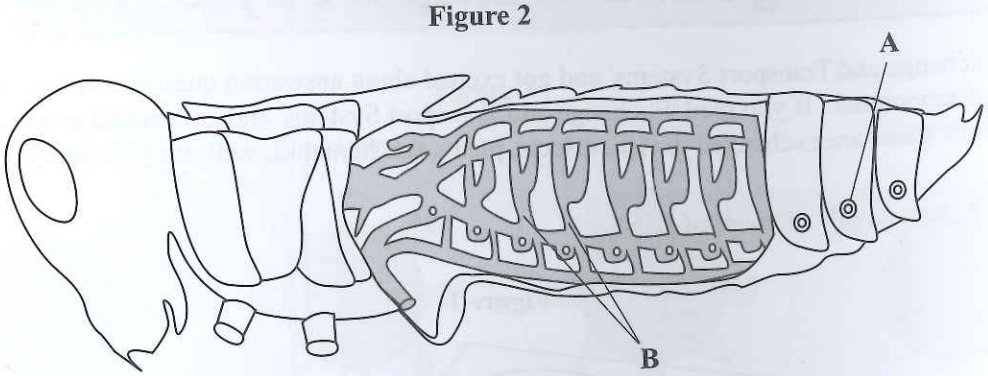
(1 mark)

Figure 2 shows a diagram of the grasshopper's gas exchange system.

Figure 2



2.2 Identify the structures labelled **A** and **B** in **Figure 2**.

A .....

B .....

(2 marks)

2.3 The student wants to examine the structures labelled **B** more closely, with the use of a temporary mount. A stain is **not** needed to view these structures.
Using this information, describe how the student would prepare the mount.

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(3 marks)

2.4 In insects, the need for efficient gas exchange can conflict with the need to limit water loss.
Give **two** ways that the grasshopper is adapted to limit water loss.

1. .....

2. .....

(2 marks)

3 A student investigated the stomatal density of a non-xerophytic plant's leaves. She studied ten samples of lower epidermis under a microscope. The samples were taken from different leaves of the same plant.

Table 1 shows the number of stomata the student counted within the microscope's field of view for each sample. The field of view measured 0.025 mm^2 in each case.

Table 1

	Sample									
	1	2	3	4	5	6	7	8	9	10
Number of stomata	5	6	7	4	3	8	5	5	3	4

3.1 Using **Table 1** and the information provided, estimate the number of stomata you would expect to find on a leaf with a surface area of 150 mm^2. Show your working.

Number of stomata: .....

(2 marks)

3.2 Give **two** reasons why your answer to question **3.1** might not be an accurate estimate of the number of stomata present on the leaf.

1. .....

2. .....

(2 marks)

3.3 Name the cells that are the site of gas exchange in a leaf.

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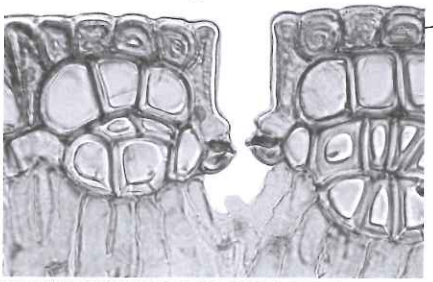
(1 mark)

Figure 3 shows an electron micrograph image of part of a xerophyte leaf.

Figure 3



DR KEITH WHEELER/SCIENCE PHOTO LIBRARY

Remember, a xerophyte is a plant that is adapted to life in warm, dry or windy habitats.

3.4 Describe and explain the xerophytic adaptation shown in **Figure 3**.

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(3 marks)

4 *Lepus capensis* and *Lepus othus* are two species of hare.
Lepus othus has relatively short ears compared to *Lepus capensis*.

4.1 Which of these two hare species would you expect to find in Alaska, where the climate is cold? Explain your answer.

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(3 marks)

4.2 Alaskan hares are hunted by larger mammals, such as polar bears. Explain how you would expect the metabolic rate of an Alaskan hare to differ from the metabolic rate of a polar bear.

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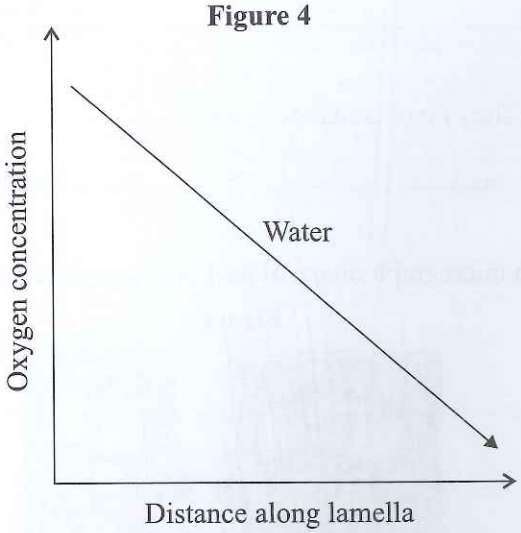
(3 marks)

5 Sharks exchange oxygen across their gill lamellae using a counter-current gas exchange system. **Figure 4** shows how the relative oxygen concentration of water changes with distance along a shark's lamella.

Figure 4

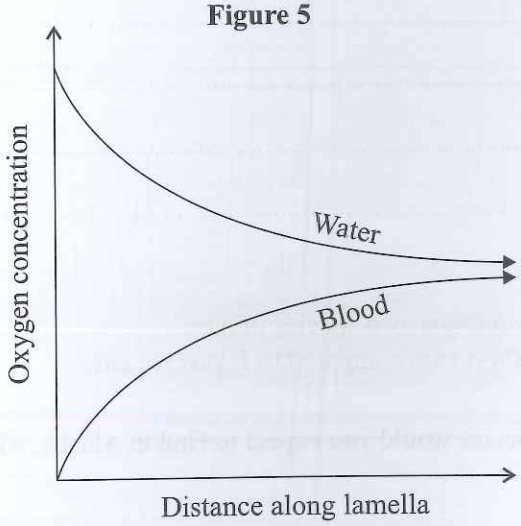


5.1 On **Figure 4**, sketch the relative oxygen concentration of the blood flowing through the lamella.

(1 mark)

Figure 5 shows how the relative oxygen concentrations of water and blood would change with distance along a shark's lamella if gas exchange took place via a parallel flow system.

Figure 5



5.2 Use **Figure 5** to explain why a parallel flow gas exchange system would be less efficient than a counter-current gas exchange system.

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(3 marks)

EXAM TIP

Make sure your working is clear in calculation questions that are worth multiple marks. Even if you get the final answer wrong, you could pick up some marks from your working — but only if the marker can tell what you were trying to do and where you got your numbers from.

Score

31

Exchange and Transport Systems — 2

1 Bacterium **A** has a surface area to volume ratio of 5 : 1. Bacterium **B** has a surface area to volume ratio of 84 : 22. Bacterium **C** has a surface area of 15.75 μm^2 and a volume of 3.5 μm^3.

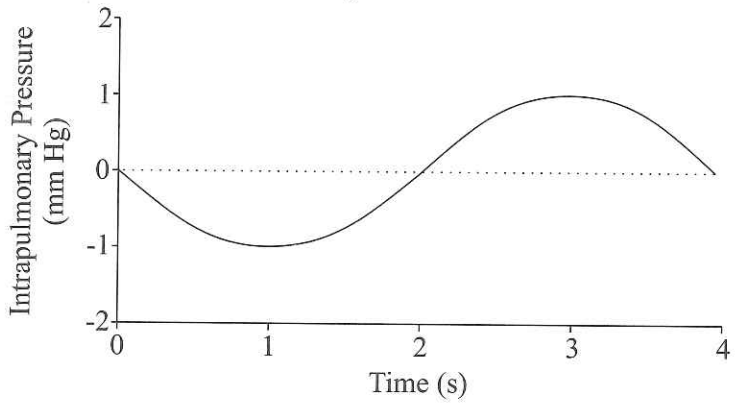
Use the information above to determine which **one** of the bacteria (**A**, **B** or **C**) is likely to be able to carry out gas exchange at the fastest rate. Show your working.

Bacterium: .....

(2 marks)

2 Intrapulmonary pressure is the pressure inside the lungs.
Figure 1 shows how intrapulmonary pressure changes during breathing.

Figure 1



2.1 Name **two** muscles that contract when a person inspires.

1. .....

2. .....

(2 marks)

2.2 State the time period in **Figure 1** during which air is being taken into the lungs.
Explain your answer.

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(3 marks)

2.3 State the time in **Figure 1** at which the lung volume is at its smallest.

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(1 mark)

3 Emphysema is a lung disease that leads to the breakdown of the alveoli walls.

3.1 Give **two** ways that healthy alveoli are adapted for gas exchange.

1. .....

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2. .....

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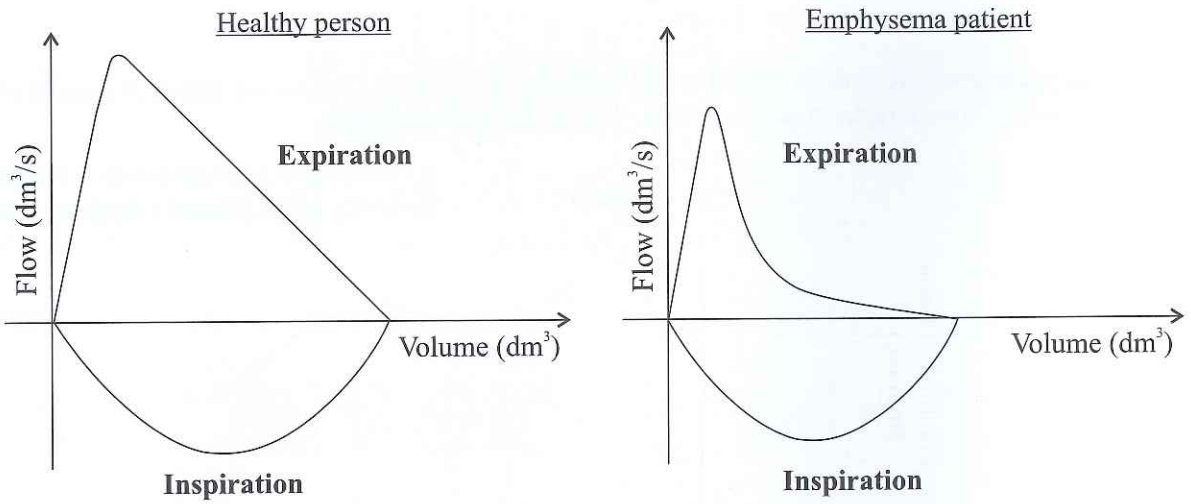
(2 marks)

Flow-volume loops show air flow during expiration and inspiration, plotted against the volume of air in the lungs. **Figure 2** shows a flow-volume loop for a healthy person and one for a patient with emphysema.

Figure 2



3.2 Suggest why the inspiration section of the emphysema patient's flow-volume loop is similar to that of the healthy person's, but the expiration section of the loop is not.

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(3 marks)

3.3 The pulmonary ventilation rate (PVR) is the volume of air inspired or expired in one minute.
A patient has a PVR of 7.60 dm^3 $minute^{-1}$ and takes 16 breaths per minute.
Calculate the volume of air in each breath in cm^3.

..... cm^3

(2 marks)

4 Asbestos is a fibrous material that was commonly used in construction work in Britain until it was banned in 1999. Long-term exposure to asbestos fibres can lead to a lung condition called asbestosis.

Asbestosis involves the build up of inelastic scar tissue in the lungs.

4.1 Suggest why people with asbestosis may have a faster ventilation rate than normal.

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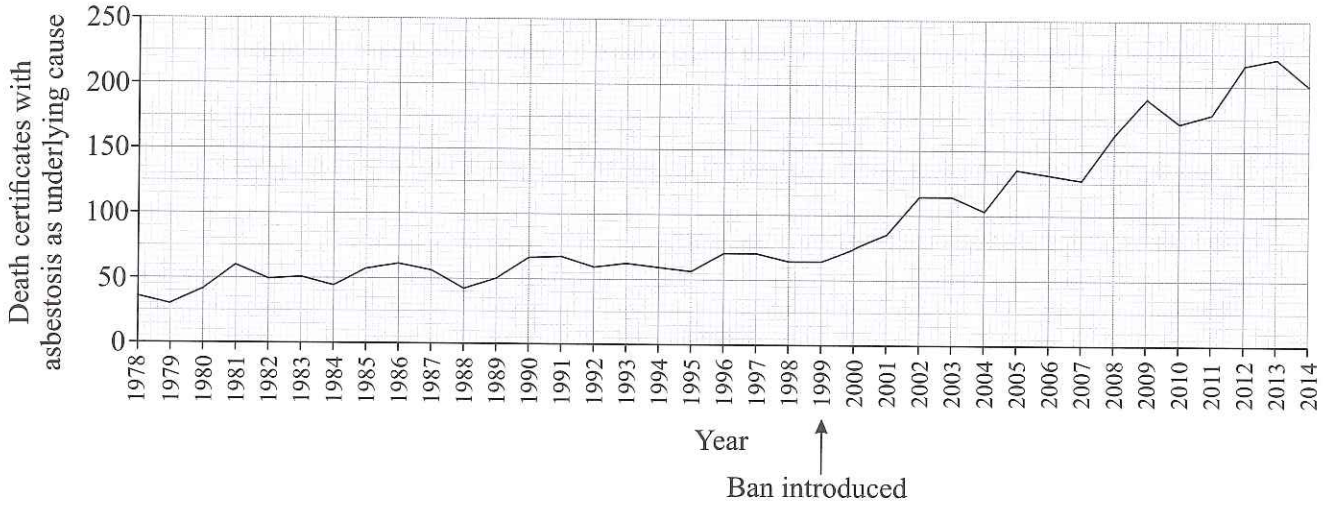
(2 marks)

Figure 3 shows the number of death certificates per year in Great Britain, which identified asbestosis as the underlying cause, from 1978 to 2014.

Figure 3



4.2 A student concludes from **Figure 3** that the asbestos ban has been unsuccessful at protecting people against asbestosis. Evaluate this conclusion.

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(4 marks)

EXAM TIP

If you're asked to evaluate something, you need to make a judgement based on the evidence you've been given. Make sure you consider both sides of the argument in your answer — think about all the possible factors that might have affected the data you're looking at.

Score

21

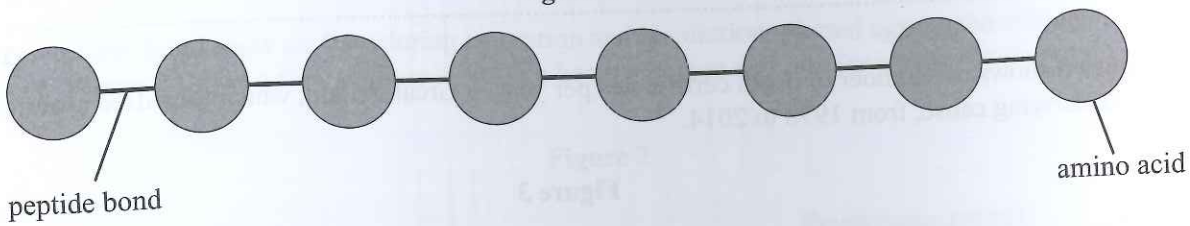
More Exchange and Transport Systems — 1

That's right — you're not done with exchange and transport systems just yet. Here's another great big section full of questions about them. You can't exchange them for something nicer, I'm afraid — get cracking.

1 Trypsin is an endopeptidase. It breaks down proteins into smaller peptides.

Figure 1 shows a protein.

Figure 1



1.1 On **Figure 1**, draw an arrow to indicate **one** place where trypsin could cleave the protein. **(1 mark)**

1.2 In addition to endopeptidases, there are **two** other types of enzymes that digest proteins.

Name these enzymes and describe how they work.

Name: .....

Function: .....

Name: .....

Function: .....

(4 marks)

1.3 The amino acids released by protein digestion are absorbed by the ileum epithelial cells. Explain how these amino acids are absorbed.

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(5 marks)

1.4 Enteropeptidase is an enzyme produced by the cells lining the small intestine when food is ingested. The role of enteropeptidase is to convert trypsinogen, an inactive enzyme, into trypsin, its active form. A mutation in one of the genes needed to make enteropeptidase can cause enteropeptidase deficiency, which can be life-threatening.

Explain why enteropeptidase deficiency could be life-threatening.

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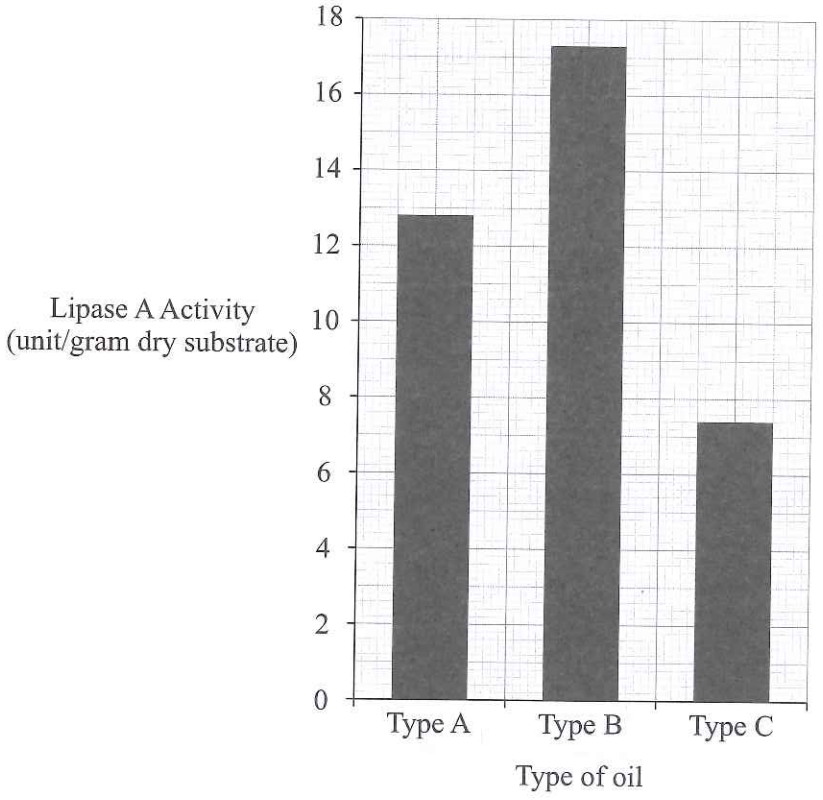
(3 marks)

2 Scientists investigated the breakdown of different types of commonly used oils by Lipase A in the small intestine. The results can be seen in **Figure 2**.

Figure 2



2.1 Lipase A is more effective at hydrolysing oil Type B than oil types A or C. Suggest an explanation for this.

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(2 marks)

2.2 Calculate the ratio of Lipase A activity for oils Type B : Type C, shown in **Figure 2**.

Ratio: ..... : 1

(1 mark)

2.3 Name **one** substance other than lipase that aids lipid digestion.

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(1 mark)

2.4 Give **two** substances that lipids are hydrolysed into.

1. .....

2. .....

(2 marks)

2.5 Describe how the products of lipid digestion are absorbed into the ileum epithelial cells.

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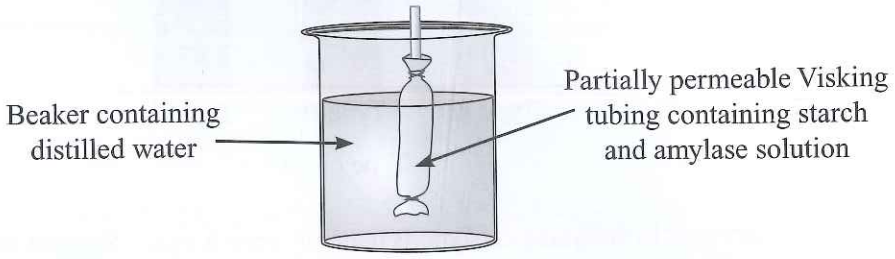
(3 marks)

3 **Figure 3** shows a model gut set up by a student to investigate the digestion and absorption of starch.

Figure 3



3.1 Describe how the student would set up a control for this investigation.

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(1 mark)

3.2 Suggest **two** reasons why this model is not wholly representative of absorption in the gut.

1. .....

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2. .....

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(2 marks)

The contents of the Visking tubing and the beaker were tested with iodine and Benedict's reagent at the start of the experiment, and after they had been left for 20 minutes. **Table 1** shows the results of these tests.

Table 1

	Iodine test result	Benedict's test result
Visking tubing contents at start	Positive	Negative
Beaker contents at start	Negative	Negative
Visking tubing contents after 20 minutes	Negative	Positive
Beaker contents after 20 minutes	Negative	Positive

3.3 Explain the iodine test results.

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(4 marks)

3.4 Explain the Benedict's test results.

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(4 marks)

EXAM TIP

Often maths questions look more complicated than they actually are, because they're written in a certain context. Try not to get put off by all the words — if it's just worth one mark, the actual calculation you have to do is probably quite straightforward. Check your answer by thinking about what sort of size you'd expect the answer to be in the context of the question.

Score

33