

# Enzymes and Digestion 3

**Q:1** Enzymes are used in biological detergents.

**(a)** Name the type of enzyme that digests stains containing fats.

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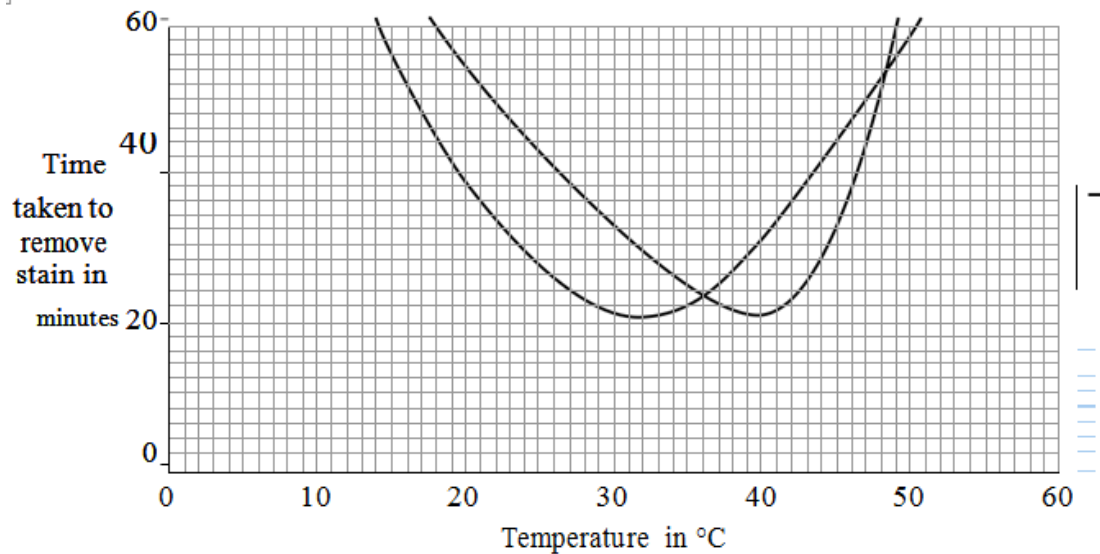
**(1 mark)**

**(b)** A new detergent is marketed as being 'environmentally-friendly'.

Scientists compared the performance of this new detergent with an existing detergent.

They measured the time taken by the two detergents to remove a fat stain at different temperatures.

The graph shows their results.



**(b)(i)** Describe the effect of increasing the temperature on the time taken by the existing detergent to remove the stain.

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**(2 marks)**

**(b)(ii)** The new detergent works at a lower temperature than the existing one.

Is the new detergent likely to be more 'environmentally-friendly' than the existing detergent?

Draw a ring around your answer.      Yes / No

Explain the reason for your answer.

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**(2 marks)**

**(c)** Neither detergent works well at 60 °C. Explain why.

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**(2 marks)**

**Q:2** A manufacturer is trying to improve the quality of the biological detergent he produces. Scientists at his company carried out the following experiments on enzymes:

- Samples of lipase were collected from five different types of bacterium, A, B, C, D and E.
- The samples were diluted to give the same concentration of lipase.
- Agar jelly containing a lipid was prepared in a dish. This forms a cloudy mixture which becomes clear when the lipid is digested.
- Five small holes were cut into the agar.
- Two drops of lipase solution from bacterium A was added to hole A.
- This process was repeated for each sample of lipase.

**Diagram 1** shows the appearance of the dish.

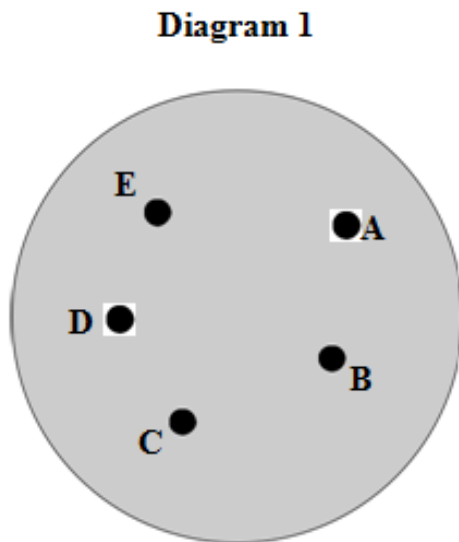
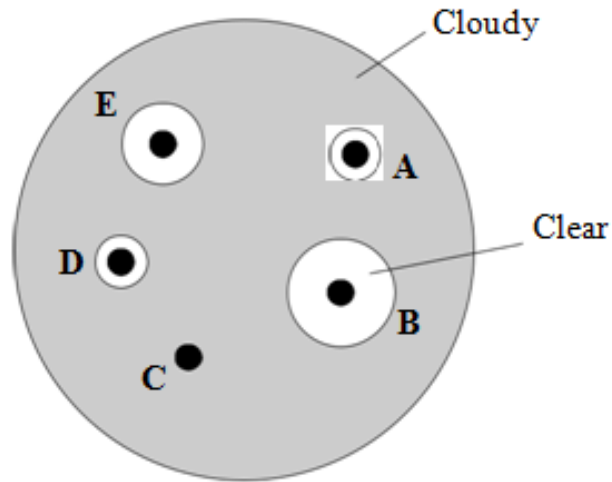


Diagram 2 shows the appearance of the dish 24 hours later.

**Diagram 2**

Cloudy

**Diagram 2**



**(a)(i)** Which type of bacterium, A, B, C, D or E, produced the most effective lipase in this investigation?

Write your answer, A, B, C, D or E, in the box.

**(1 mark)**

**(a)(ii)** Explain your answer.

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**(1 mark)**

**(b)** The manufacturer plans to add the most effective lipase to the washing powders he produces.

Suggest two other factors he should investigate before deciding which lipase is the most effective.

1. \_\_\_\_\_

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2. \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(c) Many biological detergents cannot be used at high temperatures. Explain why.

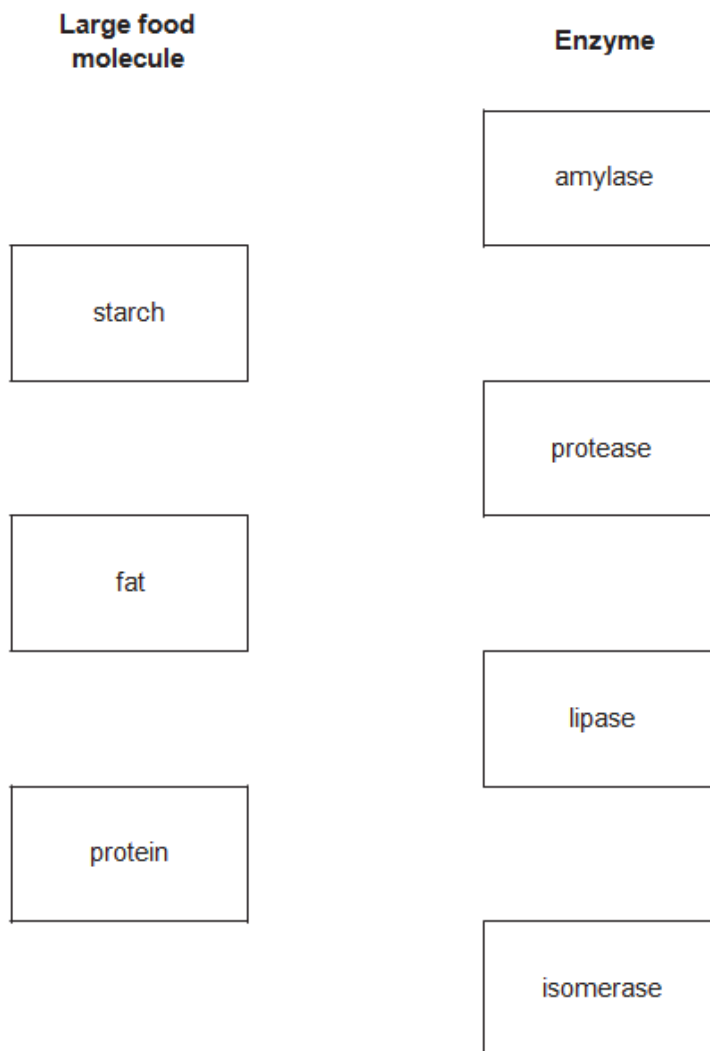
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(1 mark)

**Q:3** The body uses enzymes to digest (break down) large food molecules into smaller molecules.

(a) (i) Draw one line from each large food molecule to the enzyme that acts on it.



(3 marks)

**(a) (ii)** Draw a ring around the correct answer to complete each sentence.

Starch is broken down into

amino acids.  
fatty acids and glycerol.  
sugars.

Fat is broken down into

amino acids.  
fatty acids and glycerol.  
fructose.

Protein is broken down into

amino acids.  
fructose.  
sugars.

**(3 marks)**

**(b)** Bile helps digestion.

Where is bile produced? Draw a ring around one answer.

liver    mouth    stomach

**(1 mark)**

**Q:4** Fresh milk is a mixture of compounds including fat, protein and about 5 % lactose sugar. Lactose must be digested by the enzyme lactase, before the products can be absorbed.

Lactase can be added to fresh milk to pre-digest the lactose. This makes 'lactose-free' milk, which is suitable for people who do not produce enough lactase of their own.

A student investigated the effect of changing pH and temperature on the digestion of lactose in milk.

The results are shown in Tables 1 and 2.

**Table 1**  
Effect of pH

pH	Time taken to digest lactose in minutes
4.0	20
5.0	18
6.0	13
7.0	7
8.0	5
9.0	6

**Table 2**  
Effect of temperature

Temperature in °C	Time taken to digest lactose in minutes
30	20
35	14
40	11
45	6
50	12
55	23

**(a)** The label on a carton of lactose-free milk states:

‘Lactase is normally produced in the stomach of mammals.’

The results in Table 1 show that this statement is unlikely to be true.

Explain how.

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**(2 marks)**

**(b)** Explain as fully as you can the results shown in Table 2.

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**(3 marks)**

**(c)** Bile is produced in the liver and is released into the small intestine.

Explain how bile helps the digestion of milk.

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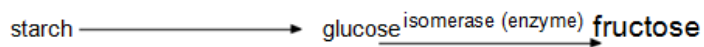
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**(2 marks)**

**Q:5(a)** Starch can be used to produce fructose for slimming foods.

The flow chart shows the process.



**(a) (i)** Isomerase is used to change glucose into fructose.

Which enzyme could be used to change the starch into glucose?

Draw a ring round one answer.

carbohydrase    isomerase    protease

**(1 mark)**



**(a) (ii)** What is the advantage of using fructose, instead of glucose, in slimming foods? Tick (☑) one box.

Fructose is not as sweet as glucose so can be used in smaller amounts.

Fructose is sweeter than glucose so can be used in larger amounts.

Fructose is sweeter than glucose so can be used in smaller amounts.

**(1 mark)**

**(b)** Enzymes are used in industry.

These are some of the properties of industrial enzymes:

- enzymes work at low temperatures
- workers have to use face masks when working with enzymes
- enzymes work in a narrow range of pH values
- enzymes can be re-used many times
- enzymes are easily broken down by high temperature
- enzymes are very expensive to buy.

Use only the information above to answer the questions.

**(b) (i)** Give two advantages of using enzymes in industry.

- 1 \_\_\_\_\_  
\_\_\_\_\_
- 2 \_\_\_\_\_  
\_\_\_\_\_

**(2 marks)**

**(b) (ii)** Give two disadvantages of using enzymes in industry.

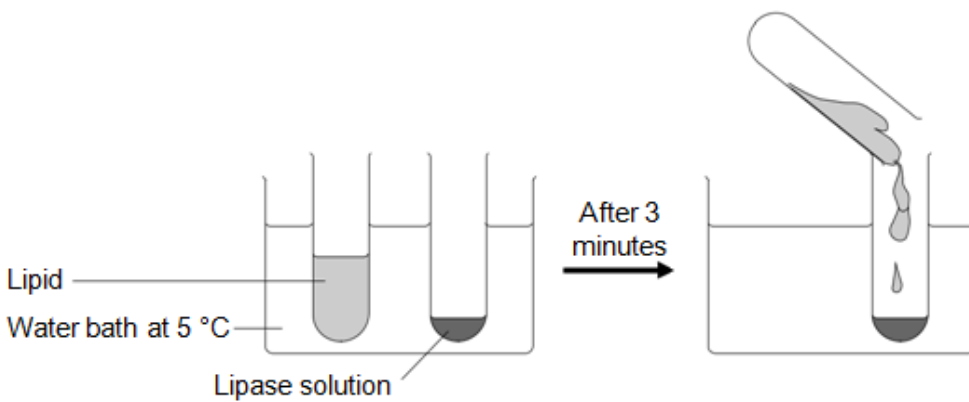
- 1 \_\_\_\_\_  
\_\_\_\_\_
- 2 \_\_\_\_\_  
\_\_\_\_\_

**(2 marks)**

**Q:6** A group of students investigated the effect of temperature on the action of the enzyme lipase.

The students:

- put 1 cm<sup>3</sup> of lipase solution into a test tube
- put 5 cm<sup>3</sup> of lipid into a different test tube
- put both tubes in a water bath at 5 °C for 3 minutes
- mixed the lipid with the lipase solution.



Every five minutes the students tested a sample of the mixture for lipid, until no lipid remained.

The students repeated the experiment at different temperatures.

**(a)** To make their investigation fair the students needed to control some variables.

Give one variable the students controlled in their investigation.

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**(1 mark)**

**(b)** The tubes of lipase solution and lipid were kept separately in the water bath for 3 minutes before mixing. Why?

Tick  one box.

So that the lipase broke down the lipid quickly

- So that the lipase and the lipid reached the right temperature
- To give enough time for the lipase to break down the lipid
- To give enough time for the water bath to heat up

(1 mark)

The table shows the students' results.

Temperature in °C	Time taken until no lipid remained in minutes
5	40
20	15
35	5
50	30
95	lipid still there after 120 minutes

(c) Describe the effect on the breakdown of the lipid of increasing the temperature from 5 °C to 50 °C.

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(2 marks)

(d) Suggest two ways in which the students could have improved their investigation.

Use information from the students' method and the results table to help you.

1 \_\_\_\_\_

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2 \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**(2 marks)**

**(e) (i)** The lipase did not break down the lipid at 95 °C.

Why?

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\_\_\_\_\_

**(1 mark)**

**(e) (ii)** At 35 °C the lipase broke down the lipid after 5 minutes.

What new substances will be in the tube?

Draw a ring around one answer.

amino acids    fatty acids and glycerol    sugars

**(1 mark)**

**TOTAL MARKS= 40**