**1** Many reactions in living organisms are catalysed by enzymes.

Amylase is an extracellular enzyme that catalyses the breakdown of the polysaccharide starch (amylose) in the digestive system of many animals.

**(a)** Why is the enzyme amylase described as being extracellular?

.....

.....

..... **[1]**

**(b)** A student investigated the effect of changing the concentration of starch on the rate of starch breakdown by amylase.

The results of the investigation are shown in Fig. 2.1.

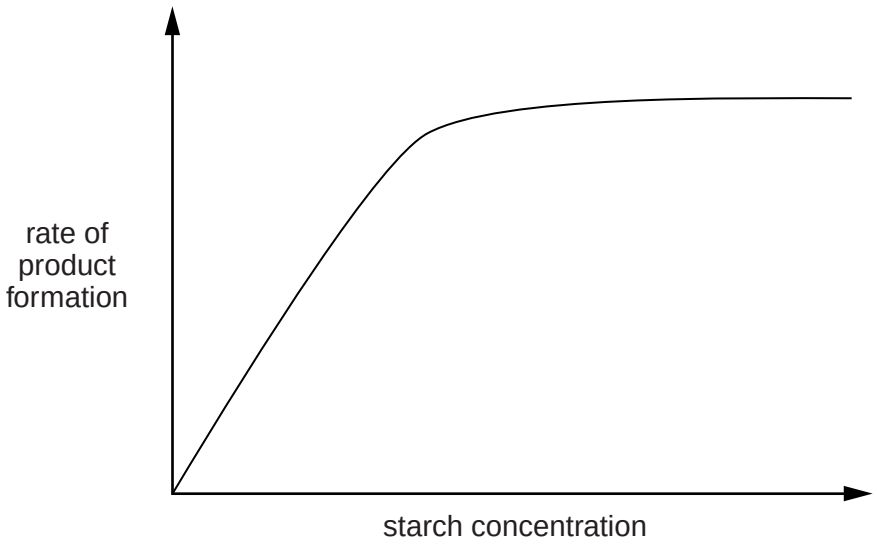


**Fig. 2.1**

**(i)** To calculate the rate of starch breakdown, the student measured the concentration of the breakdown **product**.

State the other variable the student needed to know in order to calculate the **rate** of this reaction.

..... **[1]**

**(ii)** **Explain** the shape of the graph shown in Fig. 2.1.

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..... **[5]**

**(iii)** The student kept the pH of the solution constant during the experiment.

Explain why it is important that the pH was kept constant.

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..... **[3]**

**(iv)** Suggest **two** other variables the student should have kept constant during the experiment.

1 .....

.....

2 .....

..... **[2]**

**(c)** Cellulose is another polysaccharide that is present in some living organisms.

**(i)** Complete the following table to show **three** other differences in the **structures** of starch (amylose) and cellulose molecules.

| Amylose | Cellulose |
|---|---|
| coiled | no coiling |
| | |
| | |
| | |

**[3]**

**(ii)** Which properties of cellulose make it suitable for forming cell walls?

.....

.....

..... **[2]**

**[Total: 17]**

**2** **(a)** Alcohol dehydrogenase is a protein molecule that is present in the liver. The molecule breaks down alcohols and other chemicals that would otherwise be toxic to the body.

Name the group of biological molecules to which alcohol dehydrogenase belongs.

..... **[1]**

**(b)** In 1985, health concerns were raised when the compound diethylene glycol (DEG) was detected in samples of wine. The DEG had been added, illegally, to make the wine taste sweeter.

In the liver, DEG is broken down by alcohol dehydrogenase to form a toxic product. Alcohol dehydrogenase also breaks down ethanol, the key ingredient in alcoholic drinks such as wine, to form a non-toxic product.

Fig. 2.1 shows the structures of DEG and ethanol.

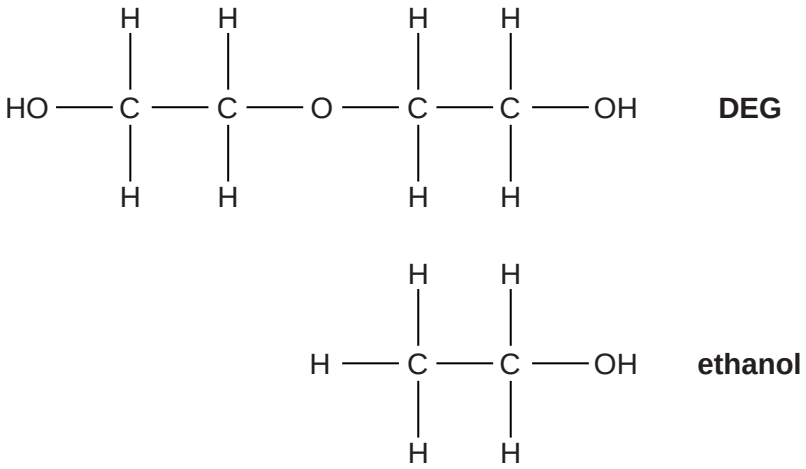


**Fig. 2.1**

**(i)** Using the information in Fig. 2.1, explain why alcohol dehydrogenase is able to break down **both** ethanol and DEG.

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..... **[3]**

**(ii)** Suggest why DEG-contaminated wines with a high ethanol content may result in less DEG poisoning than contaminated wines with a low ethanol content.

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..... **[3]**

**[Total: 7]**

**3** Enzymes are important in a wide range of biological reactions.

**(a)** Fig. 1.1 represents a mechanism of enzyme action.

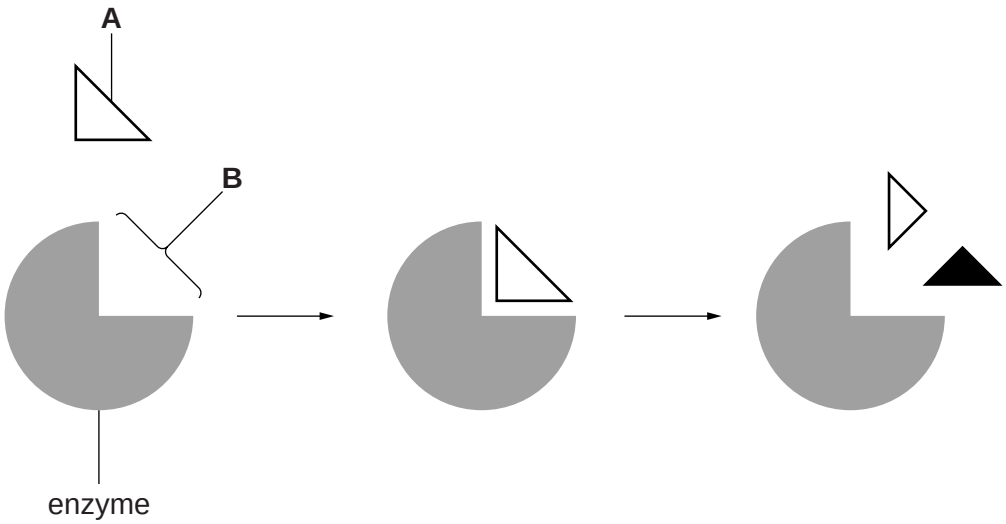


**Fig. 1.1**

**(i)** Name the structures represented by the letters **A** and **B**.

**A** .....

**B** ..... **[2]**

**(ii)** The mechanism of enzyme action was originally explained in terms of the 'lock-and-key model'. It is now more often explained in terms of the 'induced-fit' model.

Suggest why the lock-and-key and induced-fit explanations are termed **models**.

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..... **[1]**

**(iii)** Suggest why most scientists now accept the induced-fit model rather than the lock-and-key model.

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..... **[1]**

**(b)** Many fish live in the Antarctic where the water temperature can be close to 0 °C.

- Scientists have studied enzymes from these Antarctic fish and also from non-Antarctic fish that live in water at a temperature of 10 °C.
- One of the enzymes studied has been lactate dehydrogenase (LDH), an important enzyme involved in cell metabolism.
- One way in which LDH works is to catalyse the conversion of lactate to an important compound known as pyruvate.

**(i)** Scientists investigated the rates of reaction of LDH from Antarctic and non-Antarctic fish at a range of temperatures.

Suggest **three** variables that should be controlled in an investigation of this type.

1 .....

2 .....

3 ..... **[3]**

**(ii)** Some suggested controls used in this investigation are listed below.

| | |
|---|---|
| **J** | water, lactate and heated LDH (non-Antarctic at 10 °C) |
| **K** | lactate alone at all temperatures |
| **L** | lactate and water at all temperatures |
| **M** | boiled LDH (Antarctic and non-Antarctic) at all temperatures |
| **N** | pyruvate and water at all temperatures |

Select the letter, **J**, **K**, **L**, **M** or **N**, that represents the most appropriate control to be used in this investigation.

..... **[1]**

**(iii)** The rate of conversion of lactate to pyruvate at 1 °C was found to be relatively slow when catalysed with LDH from **non-Antarctic fish**.

Suggest reasons for this result.

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..... **[2]**

**(iv)** It was discovered that the rate of conversion of lactate to pyruvate at 1 °C was higher if catalysed with LDH enzyme from Antarctic fish than when catalysed with LDH enzyme from non-Antarctic fish.

Certain parts of the enzyme molecule from the Antarctic fish are more flexible than the equivalent parts of the molecule from the non-Antarctic fish.

Suggest how a more flexible structure might help this enzyme work faster at lower temperatures.

.....

.....

..... **[1]**

**(c)** Enzymes are proteins. The enzymes in Antarctic fish have a different structure from those found in non-Antarctic fish.

**(i)** Suggest how the structure of the **enzymes** may differ in Antarctic and non-Antarctic fish.

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..... **[2]**

**(ii)** Suggest how the **DNA** of the Antarctic and non-Antarctic fish might differ.

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..... **[2]**

**(d)** If species of Antarctic fish were to become extinct, their unique enzymes would be lost.

**(i)** Suggest why the loss of these **enzymes** might be undesirable.

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..... **[1]**

**(ii)** Suggest **two** ways in which the population of Antarctic fish could be conserved.

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..... **[2]**

**[Total: 18]**