Enzymes – 2021/20 GCE AS Biology A

1. Nov/2021/Paper_H020/2/No.3

Students carried out a practical investigation into the effect of enzyme concentration on the rate of reaction.

They were provided with:

- a 1% solution of the enzyme trypsin
- a supply of distilled water
- test tubes labelled 1–4
- 10 cm^3 syringes.

(a) (i) Describe how they would create **four** different enzyme concentrations using **tenfold serial dilutions**. They started by using a syringe to transfer 1 cm^3 of the 1% trypsin solution into tube 1. With a clean syringe, they then added 9 cm^3 of distilled water to tube 1.

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

(ii) State the concentration of trypsin in tube 4 once the **tenfold serial dilutions** had been completed.

Concentration = ... % **[1]**

(b) Trypsin is an example of a protease enzyme found in the small intestine of mammals. Explain why trypsin is described as an extracellular enzyme.

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

(c) **Fig. 3.1** shows how the rate of reaction of trypsin changes with pH.

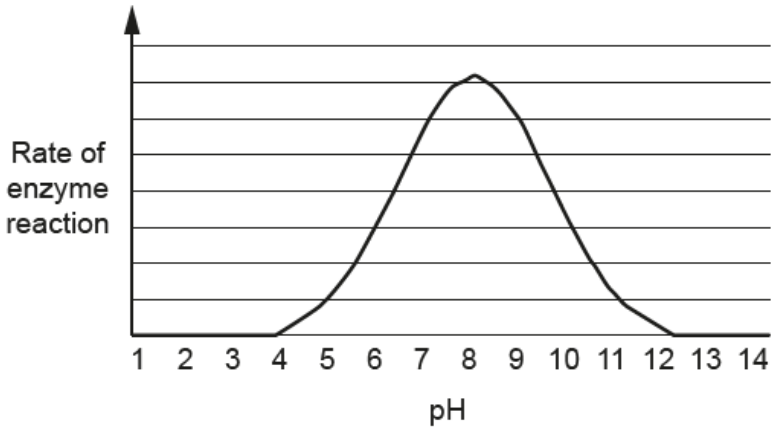

Fig. 3.1

With reference to **Fig. 3.1**, explain the change in the rate of reaction between pH 8 and pH 11.

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

(d) Catalase is an enzyme found in a wide range of tissues. It catalyses the breakdown of hydrogen peroxide into water and oxygen. A group of students used liver tissue to investigate the effect of temperature on the rate of reaction of catalase.

A diagram of the apparatus is shown in **Fig. 3.2**.

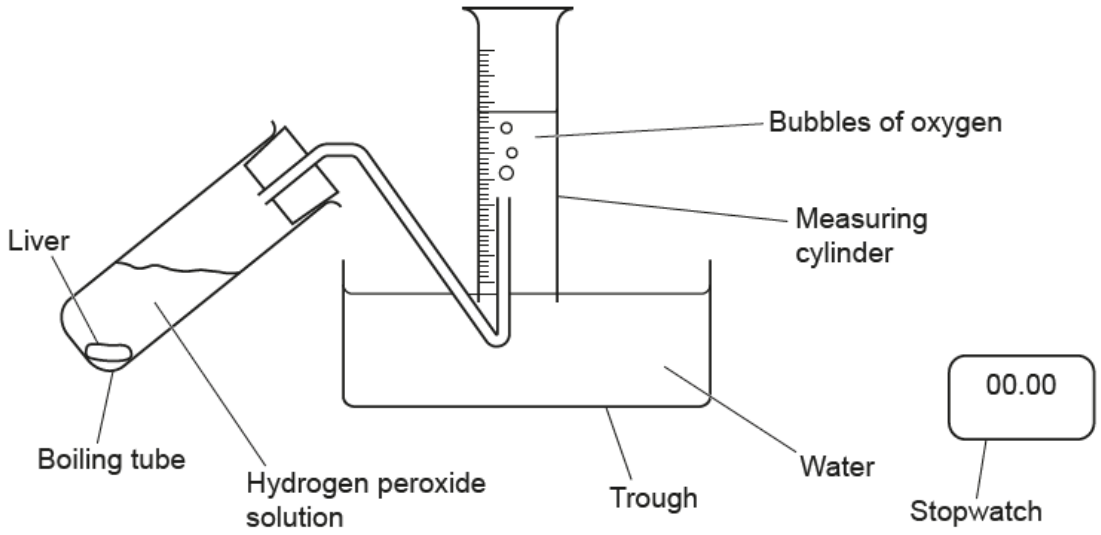

Fig. 3.2

Table 3 shows the results from the experiment carried out at 20 °C.

Time (s)	Volume of oxygen collected (cm^3)
30	6.0
60	12.0
90	15.0
120	18.0
150	21.0
180	22.0
210	23.5
240	24.0
270	24.5
300	25.0

Table 3

(i) Other factors may affect the rate of the reaction.

Name **one** other factor they would need to control **and** describe how they would control this.

Factor

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How they would control this

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[2]

(ii) Describe how you would use the apparatus shown in **Fig. 3.2** to obtain the results shown in **Table 3**.

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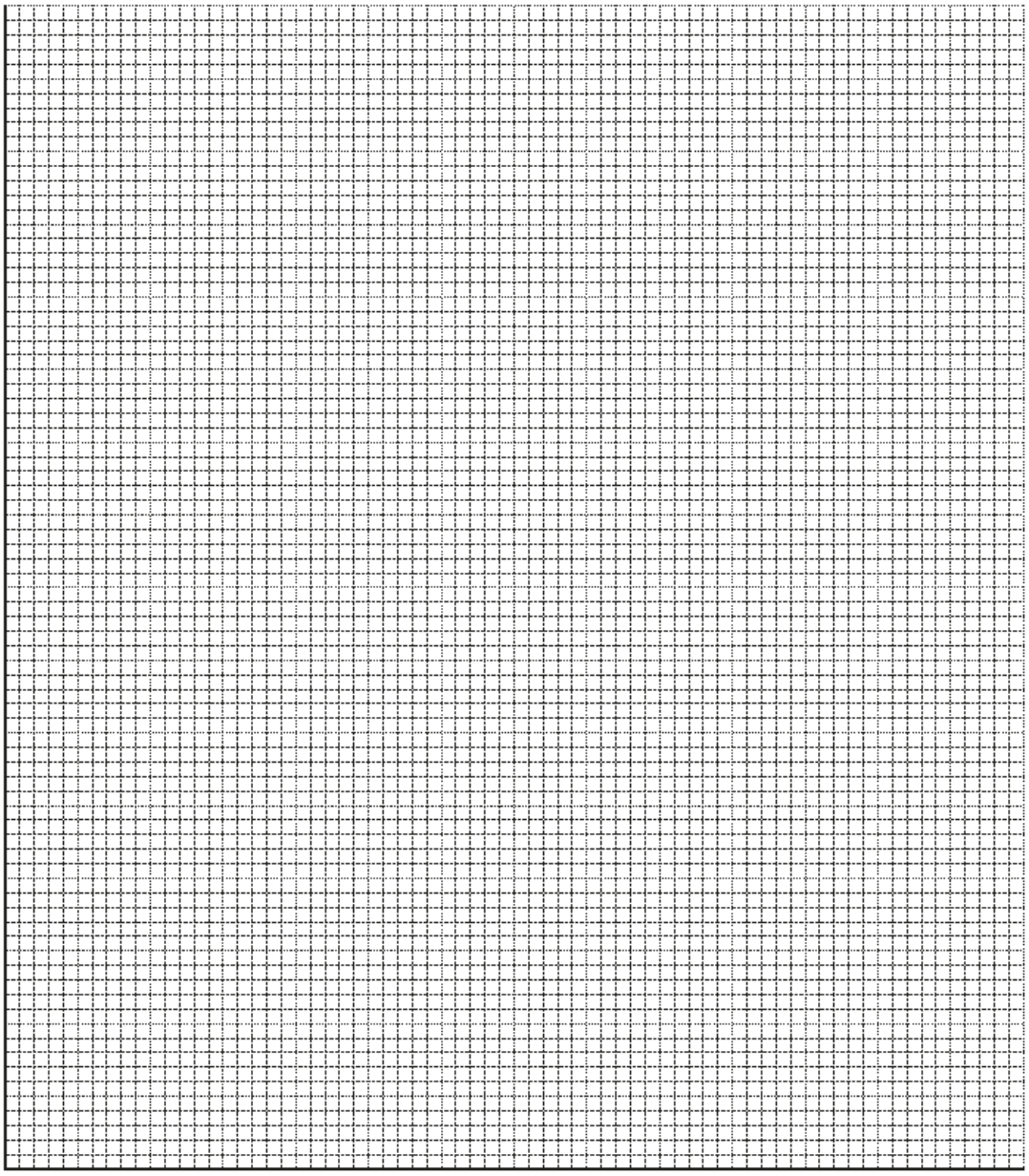
..... **[2]**

(iii) Plot a graph of the results shown in **Table 3** on the grid below.



[3]

(iv) Use your graph to calculate the **initial** rate of reaction.

Give your answer to **2** significant figures.

Rate of reaction = ... $cm^3 s^{-1}$ **[3]**

(v) The students investigating 30 °C calculated the initial rate of reaction to be 0.48 $cm^3 s^{-1}$.

Calculate the temperature coefficient (Q_{10}) for this reaction.

Give your answer to **2** significant figures.

Q_{10} = ... **[1]**

(e)* Temperature and enzyme concentration are two factors that affect the activity of enzymes.

Describe how variations in these two factors affect enzyme activity.

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..... **[6]**