

3 Enzymes – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
enzyme	酶	_____	_____	_____
active site	活性位点	_____	_____	_____
substrate	底物	_____	_____	_____
rate	速率	_____	_____	_____
kinetic energy	动能	_____	_____	_____
collide	碰撞	_____	_____	_____
optimum temperature	最适温度	_____	_____	_____
denatures	变性	_____	_____	_____
optimum pH	最适	_____	_____	_____
buffer solution	缓冲液	_____	_____	_____
Michaelis–Menten constant	米氏常数	_____	_____	_____
high affinity	亲和力	_____	_____	_____
inhibitor	抑制剂	_____	_____	_____
competitive inhibitor	竞争性抑制剂	_____	_____	_____
non-competitive inhibitor	非竞争性抑制剂	_____	_____	_____

English**中文****Write it 3 times** (English)

immobilised en- 固定化酶
zyme

Recall

From Part 1 you know an **enzyme** 酶 has an **active site** 活性位点 that fits its **substrate** 底物. Here we look at what changes the **rate** 速率 of an enzyme reaction.

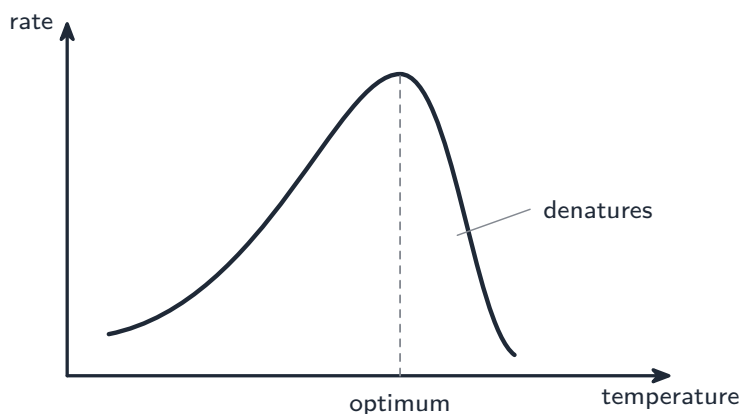
- At IGCSE you saw enzymes have a best (optimum) temperature and pH.
- Now we add the idea of *denaturing* and how to read the graphs.

New ideas

Read these first, then do the Practice.

■ 1 Temperature

As temperature rises, molecules gain **kinetic energy** 动能 and **collide** 碰撞 more often, so the rate rises. But above the **optimum temperature** 最适温度 the heat breaks the bonds holding the enzyme's shape — it **denatures** 变性. The active site changes, the substrate no longer fits, and the rate falls fast.



■ 2 pH

Each enzyme has an **optimum pH** 最适 pH. Move the pH too far from it and the enzyme denatures, so the rate drops. A **buffer solution** 缓冲液 is used to keep pH steady in an experiment.

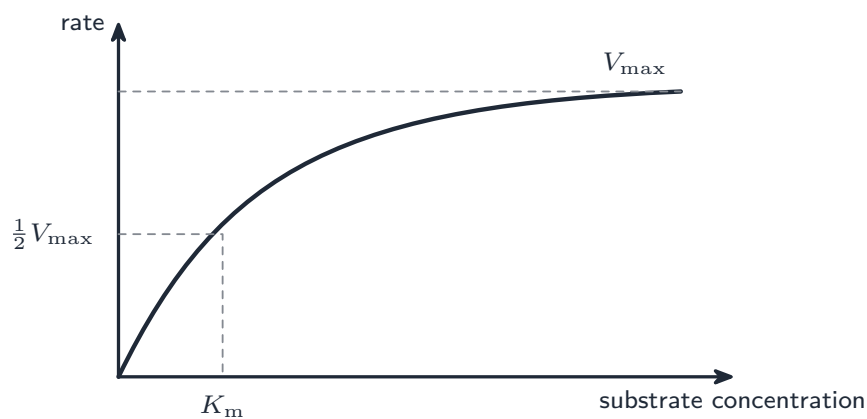
■ 3 Concentration

- more **enzyme** (with plenty of substrate) → more active sites → faster, in proportion.
- more **substrate** → faster at first, then it levels off once every active site is busy.

■ 4 $V_{\max}$ and K_m

The levelling-off rate, when all active sites are full, is the maximum rate, $V_{\max}$.

The **Michaelis–Menten constant** 米氏常数 (K_m) is the substrate concentration that gives **half** of $V_{\max}$. A **low** K_m means a **high affinity** 亲和力 (the enzyme grips its substrate strongly).



■ 5 Inhibitors

An **inhibitor** 抑制剂 slows an enzyme. Two reversible types:

- **competitive inhibitor** 竞争性抑制剂 — binds in the active site; more substrate out-competes it.
- **non-competitive inhibitor** 非竞争性抑制剂 — binds elsewhere and changes the active site; more substrate does not help.

An **immobilised enzyme** 固定化酶 is fixed in place (e.g. trapped in beads) so it can be reused and is not washed away.

Watch out: above the optimum, heat *denatures* the enzyme — the shape change is *permanent*, so the rate does *not* recover on cooling. A competitive inhibitor (in the active site) is overcome by *more* substrate; a non-competitive one is not.

Practice

Try these in order.

3.1 Explain why an enzyme reaction speeds up as temperature rises from 10 °C to its optimum. [2]

3.2 What is meant by *denature*? [1]

3.3 Why is a buffer solution used when studying the effect of temperature on an enzyme? [1]

3.4 Adding more substrate speeds the reaction at first, then has no effect. Explain why it has no effect at high concentration. [2]

3.5 Define the Michaelis–Menten constant, K_m . [1]

3.6 State where (a) a competitive and (b) a non-competitive inhibitor bind on an enzyme. [2]

3.7 Challenge. Adding more substrate reverses the effect of a competitive inhibitor,

but not a non-competitive one. Explain why.

[2]
