A-LEVEL BIOLOGY • HOLIDAY HOMEWORK 假期作业

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			
immobilised enzyme	固定化酶			

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.

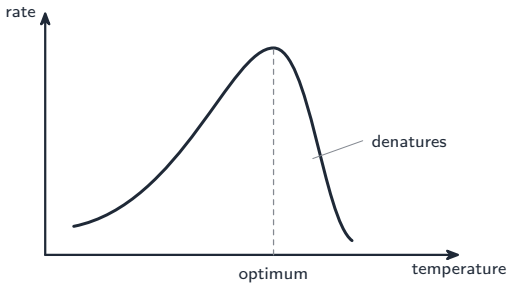
- At IGCSE you saw enzymes have a best (optimum) temperature and pH.
- Now we add the idea of *denaturing* and how to read the graphs.

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.

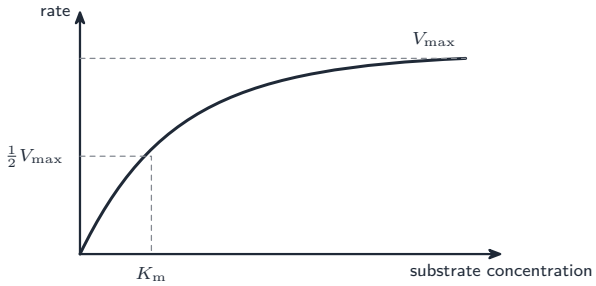
3 Concentration

- 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]