Week 6

IGCSE Biology

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

IGCSE Biology Name: _____ Score: _____

1. An enzyme is a biological catalyst, which means it:
   - ☐ speeds up a reaction without being used up
   - ☐ is used up in the reaction
   - ☐ slows reactions down
   - ☐ is a type of sugar
2. The temperature at which an enzyme works fastest is its:
   - ☐ optimum temperature
   - ☐ denaturing point
   - ☐ freezing point
   - ☐ boiling point
3. Enzymes are made of:
   - ☐ protein
   - ☐ starch
   - ☐ fat
   - ☐ glucose
4. If an enzyme gets too hot, it:
   - ☐ denatures and stops working
   - ☐ speeds up forever
   - ☐ turns into a sugar
   - ☐ works at the same rate
5. The part of an enzyme where the substrate binds is the:
   - ☐ active site
   - ☐ nucleus
   - ☐ membrane
   - ☐ product
6. The optimum temperature of most human enzymes is about how many °C?

   _____

7. Each enzyme is specific to one type of substrate.

   ☐ True ☐ False

8. The model where only a matching substrate fits an enzyme is the _____-and-key model.

   _____

9. A denatured enzyme can recover its shape once it cools down.

   ☐ True ☐ False

10. Moving the pH far from an enzyme's optimum will:

    ☐ slow or stop the enzyme

    ☐ always speed it up

    ☐ have no effect

    ☐ turn it into a substrate

5. Enzymes

Answers · 答案

IGCSE Biology

1. **speeds up a reaction without being used up**

   Catalysts speed up reactions and are reusable.

2. **optimum temperature**

   The optimum is where the rate is highest.

3. **protein**

   Enzymes are proteins.

4. **denatures and stops working**

   High temperature denatures the enzyme, destroying its active site.

5. **active site**

   The substrate fits into the active site.

6. **37**

   Human body temperature is about 37 °C.

7. **True**

   Only a matching substrate fits the active site.

8. **lock**

   Lock-and-key explains enzyme specificity.

9. **False**

   Denaturing is permanent; cooling does not restore the active site.

10. **slow or stop the enzyme**

    The wrong pH changes the active site shape.

IGCSE BIOLOGY • EXERCISE SHEET

5.1 Enzymes

Name: _____ Class: _____ Date: _____ **Total: 29 marks**

KEY WORDS enzyme 酶 • temperature 温度 • rate 速率 • catalyst 催化剂 • biological catalyst 生物催化剂

Objective

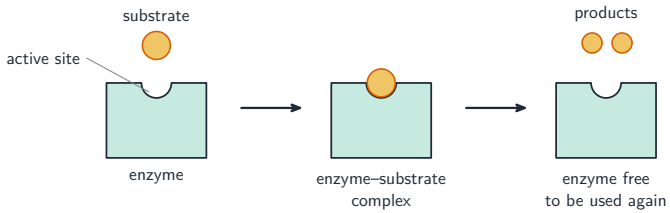
Build the skills to answer exam questions on **enzymes** 酶 — what they are, the **active site** 活性位点 and lock-and-key model, and the effects of **temperature** 温度 and **pH**.

You must be able to:

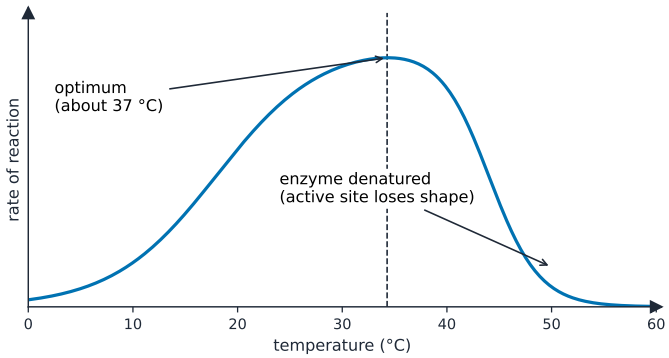
- describe enzymes as biological catalysts (proteins, not used up)
- explain enzyme action with the active site/substrate (specificity)
- explain the effect of temperature and pH, including denaturation

1 Worked examples

■ Lock-and-key and temperature



The substrate fits the active site (complementary shape); each enzyme is specific to one substrate



optimum ~37 °C for many human enzymes · higher T denatures the active site

Above the optimum the active site loses its shape — the enzyme is denatured (permanent)

■ Enzymes: the model, the graphs, and the words that earn marks

An **enzyme** 酶 is a **biological catalyst** 生物催化剂 — a protein that speeds up a reaction and is not used up, so one molecule works over and over. Each enzyme has an **active site** 活性位点 whose shape is **complementary** to its **substrate** 底物; that is why an enzyme is **specific** 专一的 and works on one substrate only. This is the **lock-and-key** model.

Temperature. Below the optimum, raising the temperature raises the rate: molecules have more **kinetic energy**, so enzyme and substrate collide more often and more successfully. Above the optimum the rate falls **sharply**: bonds holding the enzyme's shape break, the active site **changes shape**, the substrate no longer fits, and the enzyme is **denatured** 变性 — permanently, so cooling it does not restore activity.

pH. Each enzyme has an optimum pH; either side of it the rate falls, and far from it the enzyme is denatured for the same reason. Pepsin works best at about pH 2 in the stomach; amylase at about pH 7 in the mouth.

△ **Three words that lose marks.** An enzyme is **denatured**, never *killed* — it is not alive. It is the **active site** that changes shape, not "the enzyme stops working". And an enzyme is **not used up**, so "it runs out" is wrong.

Worked example. A reaction is run at 20 °C, 37 °C and 60 °C. Describe and explain the rates.

1. At 20 °C the rate is slow: little kinetic energy, so few successful collisions.
2. At 37 °C the rate is fastest: this is near the optimum for a human enzyme, with the most successful collisions per second.

3. At 60 °C the rate is very low: the enzyme has been denatured, its active site no longer fits the substrate, and the change is permanent.

2 Practice

2.1 Define a catalyst. [1]

2.2 State the type of molecule that all enzymes are made of. [1]

2.3 State two conditions that can denature an enzyme. [2]

2.4 Explain why an enzyme works on only one substrate. [2]

2.5 Predict what happens to the rate if the substrate concentration is raised while enzyme concentration stays the same. [2]

3 Exam-style questions

3.1 Above its optimum temperature, an enzyme's rate falls because the enzyme is: [1]

- **A** used up
- **B** denatured (active site changes shape)
- **C** killed
- **D** diluted

3.2 An enzyme has a specific substrate.

(a) Explain, using the lock-and-key model, why an enzyme is specific. [2]

(b) Explain why a very low pH reduces the enzyme's activity. [2]

3.3 Explain why enzyme activity increases as the temperature rises from 10 °C to 37 °C. [2]

3.4 A student measures how fast the enzyme catalase breaks down hydrogen peroxide, by counting the oxygen bubbles released each minute at different temperatures.

(a) Complete the table by predicting the relative rate at each temperature. [3]

Temperature / °C	Predicted rate (high / medium / very low)
10	
40	
70	

(b) Explain the rate you predicted at 10 °C. [2]

(c) Explain, in terms of the active site, why the rate at 70 °C is very low and does not recover on cooling. [3]

(d) State two variables the student must keep constant. [2]

(e) The student repeats the experiment at pH 3 and pH 7 at 40 °C, and finds the rate is much lower at pH 3. Explain this result. [2]

(f) State why the enzyme does not need replacing after each reaction. [2]

Solutions

2.1 a substance that speeds up a reaction but is not used up (changed) by it.

2.2 protein.

2.3 A temperature above the optimum; a pH far from the optimum.

2.4 The active site has a shape complementary to one particular substrate; a different substrate does not fit into it, so no reaction is catalysed.

2.5 The rate increases at first, then levels off because all the active sites are occupied and the enzyme concentration becomes the limiting factor.

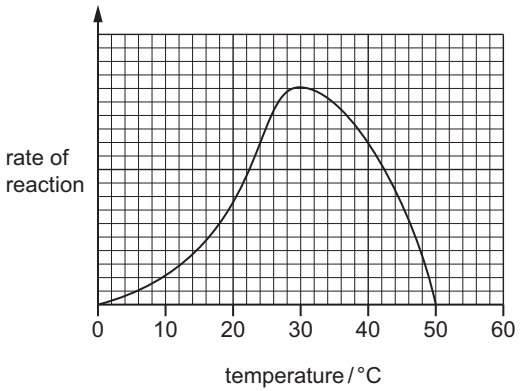
3.1 B. The active site changes shape — the enzyme is denatured.

3.2 (a) the active site has a shape complementary to one substrate; only that substrate fits, so the enzyme works on only one reaction.
(b) the wrong pH changes the shape of the active site; so the substrate no longer fits and the enzyme is denatured.

3.3 the molecules gain kinetic energy and move faster; so enzyme and substrate collide more often (giving more successful reactions).

3.4 (a) 10 °C: medium, or low; 40 °C: high; 70 °C: very low.
(b) The molecules have little kinetic energy at 10 °C, so enzyme and substrate collide less often and fewer collisions are successful.
(c) At 70 °C the bonds holding the enzyme's shape are broken; the active site changes shape so the substrate no longer fits; the enzyme is denatured, and the change is permanent, so cooling does not restore its activity.
(d) Any two of: the concentration and volume of hydrogen peroxide; the mass or concentration of catalase; the pH; the time counted.
(e) pH 3 is far from catalase's optimum of about pH 7; the active site's shape is altered, so fewer substrate molecules fit and the rate falls.
(f) An enzyme is a catalyst and is not used up in the reaction, so the same molecule catalyses the reaction again and again.

7 The graph shows the effect of temperature on an enzyme-controlled reaction.



Which statement describes the effect of temperature on this reaction?

A As the temperature increases to 25 °C, the reaction speeds up.

B Between 10 °C and 20 °C, the enzyme denatures.

C Between 35 °C and 45 °C, frequency of effective collisions increases.

D The optimum temperature for this reaction is 40 °C.

6 Which substance is an enzyme?

A fibrinogen

B mRNA

C pepsin

D saliva

3 Enzymes are biological catalysts.

(a) Describe what is meant by the term catalyst.

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..... [2]

(b) A student investigated the effect of temperature on enzyme activity.

A starch suspension was kept at 0 °C.

Amylase solution was added to the starch suspension.

Samples of the starch and amylase mixture were tested with iodine solution at 1-minute intervals for 15 minutes.

The student recorded the time at which the starch and amylase mixture stopped turning a blue-black colour.

The student repeated this investigation at different temperatures.

Table 3.1 shows the results.

Table 3.1

temperature / °C	time at which the starch and amylase mixture stopped turning a blue-black colour / minutes
0	stayed blue-black
10	12
20	8
30	5
40	3
50	10
60	stayed blue-black

(i) Explain the results between 0 °C and **40 °C** in Table 3.1.

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..... [6]

(ii) This investigation was repeated with protease instead of amylase.

Explain why the samples from the mixture produced a blue-black colour at every temperature.

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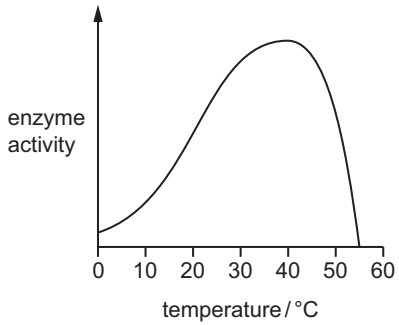
..... [2]

(c) State **one** factor, other than temperature, that affects enzyme action.

..... [1]

[Total: 11]

7 The graph shows how enzyme activity is affected by temperature.



Why is enzyme activity lower at 55 °C than it is at 40 °C?

A Heat has killed the enzyme.

B The enzyme has been used up.

C The reactants are moving faster.

D The substrate is less likely to fit into the active site.

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8 What is the correct definition of enzymes?

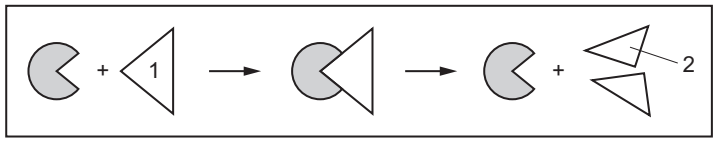
A carbohydrates that act as biological catalysts

B carbohydrates that act as substrates

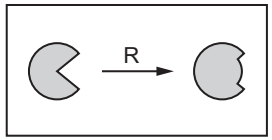
C proteins that act as biological catalysts

D proteins that act as substrates

5 The diagram shows a process involving an enzyme in the human stomach.



The diagram shows another process, R, that affects this enzyme.



Which row identifies the substrate and the cause of process R?

	substrate	cause of process R
A	1	acidic conditions
B	1	alkaline conditions
C	2	acidic conditions
D	2	alkaline conditions

6 A scientist investigated the effect of changes in pH on the activity of two different protease enzymes.

Each enzyme was placed in a hole in the centre of a jelly layer in a Petri dish. The jelly layer was made of protein. The investigation was carried out at a range of different pH values.

After 60 minutes, the area of the jelly layer that had been broken down by enzyme **L** or enzyme **M** was recorded at each pH value tested.

Fig. 6.1 is a diagram of the apparatus.

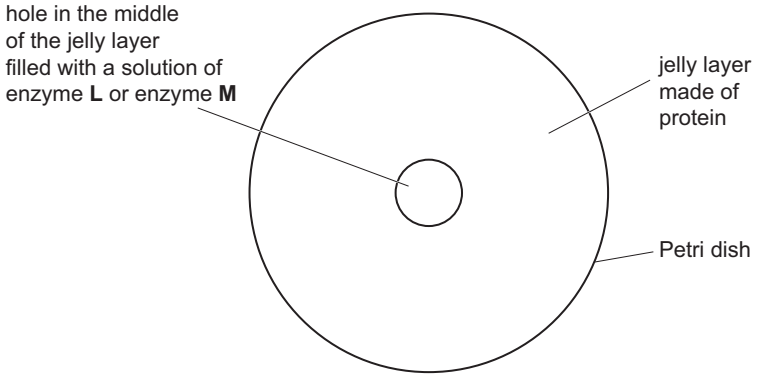


Fig. 6.1

Fig. 6.2 shows the results of the investigation.

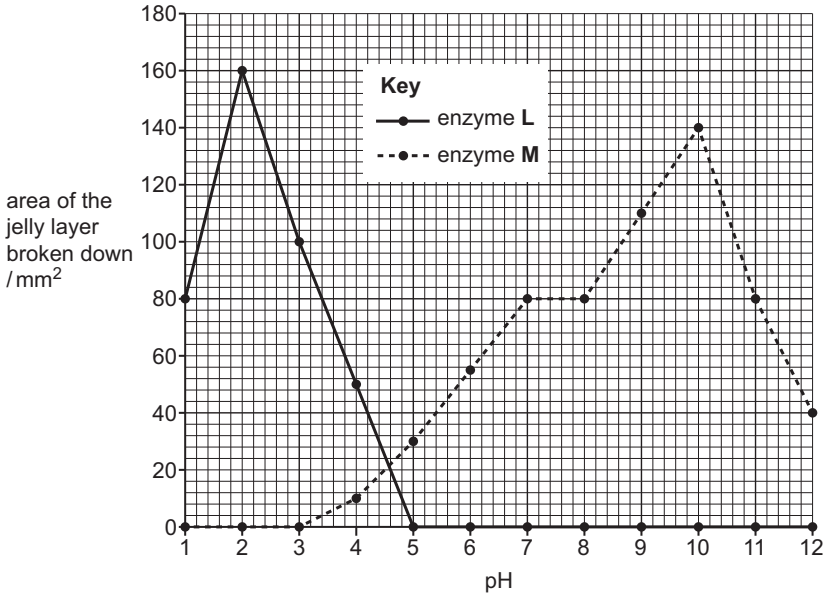


Fig. 6.2

(a) Using the information in Fig. 6.2, describe the results of this investigation.

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..... [5]

(b) Explain the result for enzyme **M** at pH 2 shown in Fig. 6.2.

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..... [3]

(c) Suggest the name of enzyme **L and** state its location in the human digestive system.

name of enzyme **L** .....

location .....

[2]

[Total: 10]

2 **(a)** The enzyme pectinase is used in the production of apple juice.

In an experiment, a student investigated the production of apple juice using five different concentrations of pectinase solution.

For each concentration, the student:

- put 100 g of crushed apple into a beaker
- added 10 cm^3 of the pectinase solution to the crushed apple
- left the crushed apple and enzyme mixture for 30 minutes at 40 °C
- filtered the apple juice from the mixture
- measured the volume of apple juice produced.

(i) The temperature was maintained at 40 °C.

Describe how the student could maintain the crushed apple and enzyme mixture at a constant temperature.

.....

.....

..... [1]

(ii) State **two other** variables that were kept constant in this investigation.

1 .....

.....

2 .....

.....

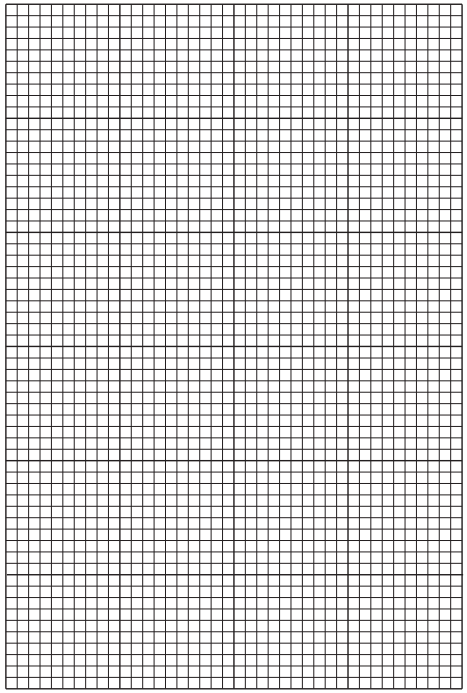
[2]

(b) The results of this investigation are shown in Table 2.1.

Table 2.1

percentage concentration of the pectinase solution	volume of apple juice produced / cm^3
0.1	4
0.2	6
0.4	12
0.8	22
1.6	22

(i) Plot a line graph on the grid of the data in Table 2.1.



[4]

(ii) Use your graph to estimate the volume of apple juice produced with a 0.5% pectinase solution.

Show on your graph how you obtained your answer.

..... cm^3
[2]

(iii) Describe the effect of pectinase solution concentration on apple juice production.

.....

.....

..... [1]

(iv) Pectinase is used to produce apple juice commercially.

Suggest what extra data would be required to determine if a 0.8% pectinase solution is the optimum concentration for the production of apple juice.

.....

.....

..... [1]

(v) Draw and label the apparatus the student could use to filter **and** measure the volume of apple juice produced.

[3]

[Total: 14]

9 Which statement describes enzymes?

A Enzymes are carbohydrates.

B Enzymes are involved in metabolic reactions.

C Enzymes decrease the rate of reaction.

D Enzymes have the same shape of active site as their substrate.