



Enzymes and metabolism: practice questions

8 questions • 23 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 23

1 PAPER 1A STYLE [1 mark]

Which process is an example of catabolism?

- A. ☐ Formation of glycogen from glucose in liver cells
- B. ☐ Synthesis of a polypeptide at a ribosome
- C. ☐ Hydrolysis of starch to maltose in the small intestine
- D. ☐ Production of glucose in photosynthesis

2 PAPER 1A STYLE [1 mark]

Which statement describes induced-fit binding?

- A. ☐ The active site is a rigid shape exactly complementary to the substrate before binding.
- B. ☐ Both the substrate and the active site change shape when binding occurs.
- C. ☐ The substrate changes shape but the enzyme does not.
- D. ☐ The enzyme denatures slightly each time a substrate binds.

3 PAPER 1A STYLE [1 mark]

HL only

Statins lower blood cholesterol by inhibiting an enzyme in its synthesis pathway. As statins are competitive inhibitors, which change would reduce their effect?

- A. ☐ Increasing the concentration of the enzyme's substrate
- B. ☐ Lowering the temperature of the reaction
- C. ☐ Adding a substance that binds to the allosteric site
- D. ☐ Decreasing the concentration of the enzyme's substrate

4 PAPER 1B STYLE

[5 marks]

Students investigated the effect of temperature on the activity of catalase extracted from potato. They measured the volume of oxygen released from hydrogen peroxide in the first 60 seconds. The data are for practice and show the mean of three repeats. (a) Calculate the mean rate of oxygen production at 35 °C, in $\text{cm}^3 \text{s}^{-1}$. [1] (b) Describe the effect of temperature on the volume of oxygen released. [2] (c) Explain the result at 55 °C. [2]

Volume of oxygen released in 60 s at different temperatures	
Temperature / °C	Mean volume of oxygen in 60 s / cm^3
15	6.0
25	11.4
35	19.8
45	15.6
55	2.4

Answer =

.....

.....

.....

.....

.....

.....

.....

.....

.....

5 PAPER 2A STYLE

[2 marks]

Outline how the structure of a globular protein allows it to act as an enzyme.

.....

.....

.....

.....

6 PAPER 2A STYLE

[3 marks]

Explain how an enzyme increases the rate of a reaction, with reference to activation energy.

.....

.....

.....

.....

.....

PAPER 2A STYLE

HL only

```
.....
.....
.....
.....
.....
.....
```

PAPER 2B STYLE

HL only

[illegible]

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

C C [1]

2. [1]

B B [1]

3. [1] **HL only**

A A [1]

4. [5]

- (a) $19.8 \div 60 = 0.33 \text{ cm}^3 \text{ s}^{-1}$ [1]
- (b) volume increases from 15 °C to 35 °C / up to an optimum of about 35 °C [1]
- (b) volume decreases above 35 °C, falling steeply to 2.4 cm³ at 55 °C [1]
- (c) (most) catalase molecules are denatured / bonds holding tertiary structure break [1]
- (c) active site changes shape so hydrogen peroxide cannot bind / fewer enzyme-substrate complexes form [1]
- (c) accept: some enzyme molecules still active so a little oxygen is produced [1]
- (c) [max 2]

5. [2]

- active site formed from only a few amino acids / R groups [1]
- interactions between amino acids elsewhere in the folded (tertiary) structure hold the active site in its shape [1]
- active site has shape/chemical properties that bind the substrate / allow catalysis OWTTE [1]
- globular protein is soluble so can move / collide with substrate [1]
- [max 2]

6. [3]

- activation energy is energy needed to break bonds in the substrate / to start the reaction [1]
- binding to active site stresses / weakens bonds in the substrate [1]
- enzyme lowers the activation energy [1]
- so more substrate molecules have enough energy to react (at a given temperature) [1]
- overall energy change of the reaction is not altered [1]
- [max 3]

7. [3] **HL only**

- (a) intracellular: occur inside the cell, e.g. glycolysis in cytoplasm / Krebs cycle in mitochondrial matrix [1]
- (a) extracellular: enzyme secreted and acts outside the cell, e.g. chemical digestion in the gut [1]
- (b) reactions are not 100% efficient in energy transfer / some energy is lost as heat [1]

8. [7] HL only

- non-competitive inhibitor binds to allosteric site (not the active site) [1]
- only specific substances bind to an allosteric site [1]
- binding causes conformational change that alters the active site so catalysis is prevented [1]
- binding is reversible [1]
- feedback inhibition: end product inhibits an enzyme early in the pathway [1]
- isoleucine inhibits threonine deaminase / first enzyme of the pathway from threonine [1]
- high isoleucine slows the pathway; low isoleucine allows it to resume, keeping concentration stable / avoids waste [1]
- mechanism-based inhibition: inhibitor binds irreversibly / covalently to the active site and changes it chemically [1]
- penicillin inhibits transpeptidases that cross-link peptidoglycan in bacterial cell walls [1]
- bacteria with altered transpeptidases (to which penicillin cannot bind) are resistant [1]
- [max 7]