

# Proteins and enzymes: practice questions

8 questions · 27 marks · mark scheme at the back

For Pearson Edexcel International AS Biology XBI11 and International A Level Biology YBI11. **A Level only** is IA2 content (Units 4 to 6), not needed for the International AS.

Name .....

Total ..... / 27

**1** UNIT 1 STYLE [1 mark]

Which statement correctly describes the formation of a peptide bond?

- A. ☐ A condensation reaction between the amino group of one amino acid and the carboxyl group of another, releasing water
- B. ☐ A hydrolysis reaction between the amino group of one amino acid and the carboxyl group of another, using water
- C. ☐ A condensation reaction between the R groups of two amino acids, releasing water
- D. ☐ A hydrolysis reaction between the R groups of two amino acids, using water

**2** UNIT 1 STYLE [3 marks]

Describe how two amino acids are joined to form a dipeptide.

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**3** UNIT 1 STYLE [5 marks]

Explain how the primary structure of a protein determines its tertiary structure. Name the types of bond that hold the tertiary structure.

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4

UNIT 1 STYLE

[4 marks]

Compare and contrast the structure and function of haemoglobin and collagen.

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UNIT 1 STYLE

[3 marks]

Explain why an enzyme is specific for its substrate and how it speeds up a reaction.

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**6** UNIT 1 STYLE

[4 marks]

The enzyme catalase breaks down hydrogen peroxide to produce oxygen. The table shows the volume of oxygen collected over the first 60 seconds. Calculate the initial rate of the reaction in  $\text{cm}^3 \text{ s}^{-1}$ , using the first 20 seconds of the results, and explain why the rate of reaction between 40 and 60 seconds is lower.

| Volume of oxygen collected |                                  |
|----------------------------|----------------------------------|
| Time / s                   | Volume of oxygen / $\text{cm}^3$ |
| 0                          | 0.0                              |
| 10                         | 6.5                              |
| 20                         | 11.0                             |
| 30                         | 14.0                             |
| 40                         | 15.5                             |
| 50                         | 16.3                             |
| 60                         | 16.5                             |

Answer = .....

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**7** UNIT 3 STYLE

[6 marks]

A student investigated the effect of pH on the initial rate of reaction of catalase with hydrogen peroxide. She added the enzyme to each buffered hydrogen peroxide solution and measured the volume of oxygen collected in 2 minutes. Suggest how her method could be improved so that the initial rates can be compared validly, and describe how she should process her results.

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**8**

UNIT 1 STYLE

**[1 mark]**

Which of the following is an extracellular enzyme?

- A. ☐ Catalase in a liver cell
- B. ☐ Amylase secreted into the small intestine
- C. ☐ DNA polymerase in the nucleus
- D. ☐ An enzyme of respiration in a mitochondrion

## Mark scheme

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

### 1. [1]

**A** A. Peptide bonds form between the carboxyl group of one amino acid and the amino group of the next, in a condensation reaction that releases water. R groups are not involved in the peptide bond.

### 2. [3]

- condensation reaction (1)
- between the carboxyl group of one amino acid and the amino group of the other / OH from the carboxyl and H from the amino group removed (1)
- water released / peptide bond formed between C and N (1)

### 3. [5]

- primary structure is the sequence of amino acids / R groups (1)
- determines where hydrogen bonds / ionic bonds / disulfide bonds can form between R groups (1)
- so the chain folds into a specific three-dimensional shape (1)
- so a change in one amino acid can change the folding / the three-dimensional shape (1)
- hydrogen bonds and ionic bonds (1)
- disulfide bonds (between cysteine R groups) (1)
- hydrophobic interactions between non-polar R groups (1)
- Max 5

### 4. [4]

- similarity: both have quaternary structure / more than one polypeptide chain / both are proteins (1)
- haemoglobin is globular and collagen is fibrous (1)
- haemoglobin is soluble (hydrophilic R groups outside), collagen is insoluble (1)
- haemoglobin has four chains each with a haem group, collagen has three chains in a triple helix (1)
- haemoglobin transports oxygen, collagen provides strength / support (1)
- Max 4

### 5. [3]

- active site has a specific shape / three-dimensional structure (1)
- complementary to the substrate / only one substrate fits, forming an enzyme-substrate complex (1)
- active site shape is determined by the tertiary structure / the primary structure (1)
- lowers the activation energy (1)
- active site changes shape slightly (induced fit), putting strain on bonds in the substrate (1)
- Max 3

### 6. [4]

- change in volume ÷ change in time (1)
- $11.0 \div 20$  (1)
- $0.55 \text{ cm}^3 \text{ s}^{-1}$  (1)
- correct answer with no working gains 3 marks; do not accept  $0.65 \text{ cm}^3 \text{ s}^{-1}$  (first 10 s only)
- substrate concentration has fallen / substrate used up, so fewer collisions and fewer enzyme-substrate complexes formed (1)

**7. [6]**

- measure volume at regular short intervals (e.g. every 10 seconds) rather than one reading at 2 minutes (1)
- plot volume against time and calculate the initial rate from the gradient of a tangent at time zero (1)
- keep temperature constant / use a water bath for all pH values (1)
- same volume and concentration of enzyme and hydrogen peroxide for each pH (1)
- bring solutions to temperature before mixing (1)
- repeat each pH at least three times and calculate a mean / identify anomalies (1)
- use a gas syringe for accurate volumes (1)
- Max 6

**8. [1]**

**B** B. Amylase is secreted and acts outside the cells that make it. The others all work inside cells.