

Exercise walk-through

1.10

Amino acids, proteins and enzymes (statements 2.6–2.8, core practical 4)

Pearson Edexcel · International A-Level · Biology

Sugars join and split

Condensation : two monosaccharides lose one water molecule and bond



Glycosidic bond : the C-O-C link between the sugars



Hydrolysis : digestive enzymes add water back and separate them

Read a health study like an examiner

Your turn

Gum disease correlates with endothelial damage. List three checks before claiming causation.

- A. Who was sampled, how selected, how many?
- B. Were confounders like smoking, age, diet controlled?
- C. Is there a mechanism and a dose-response pattern?

DNA copies itself semi-conservatively

Unzip : helicase breaks the hydrogen bonds between the strands

Template : each old strand pairs with free nucleotides by complementary base pairing

Join : DNA polymerase links the nucleotides into a new strand

Exercises 2.1·2.3

2.1 Describe how a peptide bond forms between two amino acids. [3]

2.2 Explain why a change in pH can reduce enzyme activity without denaturing the enzyme. [2]

2.3 State what happens to the rate of an enzyme reaction when substrate concentration is doubled from a very low value, and when doubled from a saturating value. [2]

Exercises 2.1·2.3

2.1 Describe how a peptide bond forms between two amino acids. [3]

2.1 A condensation reaction between the amino group of one amino acid and the carboxyl group of the next removes a molecule of water and forms a peptide bond.

2.2 Explain why a change in pH can reduce enzyme activity without denaturing the enzyme. [2]

2.2 Away from the optimum, the ionisation of R groups in the active site changes, so the active site's shape or charge no longer fits the substrate well – activity falls before the tertiary structure itself breaks down.

2.3 State what happens to the rate of an enzyme reaction when substrate concentration is doubled from a very low value, and when doubled from a saturating value. [2]

2.3 From very low: rate approximately doubles. From saturating: no change – the enzyme's active sites are already all occupied.

Exercise 3.1

3.1 The table shows the rate of an enzyme-controlled reaction at five temperatures.

Temperature / °C	Rate / $\mu\text{mol min}^{-1}$
10	4
20	9
30	17
40	24
50	6

Calculate the Q₁₀ between 10 °C and 20 °C, describe the trend including what happens above 40 °C, and explain the fall at 50 °C in terms of protein structure. [6]

Exercise 3.1

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Temperature / °C	Rate / $\mu\text{mol min}^{-1}$
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Calculate the Q_{10} between 10 °C and 20 °C, describe the trend including what happens above 40 °C, and explain the fall at 50 °C in terms of protein structure. [6]

3.1 $Q_{10} = 9/4 = 2.25$. Rate rises with temperature up to an optimum at 40 °C, then collapses to $6 \mu\text{mol min}^{-1}$ by 50 °C. Above the optimum, kinetic energy breaks the hydrogen and ionic bonds holding the tertiary structure, the active site's shape is lost (denaturation) and substrate no longer fits.

Exercises 3.2-3.3

3.2 An enzyme digests plastic. Chemical A added to the reaction does not change the rate at saturating substrate but lowers it at all lower concentrations by the same fraction. Chemical B added alone lowers the rate at every substrate concentration. Identify the type of inhibition for A and for B, and explain each observation. [5]

3.3 Amylase is linked to a second enzyme so that starch is broken down and the product immediately converted in one place. Suggest how linking the two enzymes could increase the overall rate of product formation, referring to the movement of the intermediate molecule. **[4]

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3.2 A is competitive: it competes for the active site, so at saturating substrate it is always out-competed and the maximum rate is unchanged. B is non-competitive: it binds away from the active site and distorts the enzyme's shape, effectively removing enzyme whatever the substrate concentration, so the rate falls at every concentration.

3.3 Amylase is linked to a second enzyme so that starch is broken down and the product immediately converted in one place. Suggest how linking the two enzymes could increase the overall rate of product formation, referring to the movement of the intermediate molecule. **[4]

3.3 The intermediate does not have to diffuse away to find the second enzyme; its local concentration at the second active site is far higher, so it is converted as soon as it is made, raising throughput of the two-step sequence overall.