InkBiology

ANSWER BOOK

Inhibition: how cells, poisons and medicines all turn enzymes down

Enzymes and metabolic control · Unit B03

AQA 3.1.4.2 · OCR A 2.1.4 (i)-(k) · Edexcel A Topic 1.8 · CAIE 3.2

6 questions · 20 marks

NAVY EDITION

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SECTION A · Short, 1 to 2 marks

A1 **B1** Vmax is lowered by a non-competitive inhibitor. **B1** Km is unchanged by a non-competitive inhibitor. [2]

SECTION B · Standard, 3 to 5 marks

B1 **B1** a competitive inhibitor binds to the active site, whereas a non-competitive inhibitor binds elsewhere, at an allosteric site. **B1** a competitive inhibitor has a shape similar to the substrate, whereas a non-competitive inhibitor has a shape unrelated to it. **B1** a competitive inhibitor blocks the site, whereas a non-competitive inhibitor alters the tertiary structure so the site is no longer complementary to the substrate. **B1** raising the substrate concentration overcomes competitive inhibition, but has no effect at all on non-competitive inhibition. [4]

B2 **B1** the final product of the pathway acts as a non-competitive inhibitor of the first enzyme, binding at an allosteric site. **B1** as product accumulates more of that first enzyme is inhibited, so the pathway slows. **B1** as product is used up the inhibitor comes off again, so the pathway speeds up and its rate matches demand. **B1** inhibiting the last enzyme instead would leave the earlier steps running, so substrate and ATP would be spent building intermediates the cell has no use for. [4]

B3 **B1** the immobilised enzyme stays on its support as the milk flows past, so it is recovered and reused instead of being lost with every batch. **B1** no enzyme leaves with the product, so no separation step is needed and the milk contains none of the enzyme protein. **B1** the support holds the tertiary structure, so the column tolerates a higher temperature and can be run continuously rather than in batches. **B1** against this, an immobilised enzyme works more slowly because part of the active site may be blocked and substrate must diffuse to it, and set-up costs are higher; since reuse repays those costs within days, immobilising is the better choice. [4]

B4 **B1** penicillin resembles the piece of peptidoglycan that the bacterial transpeptidase normally grips, closely enough to enter that enzyme's active site. **B1** it then forms a covalent bond with the enzyme, so the inhibition is irreversible, the growing bacterium cannot cross-link its wall, and it bursts as water enters by osmosis. **B1** human cells have no peptidoglycan wall and therefore no transpeptidase, so there is nothing for penicillin to inhibit. [3]

B5 **B1** mercury ions bind to the sulfur in cysteine side chains. **B1** the disulfide bridges those cysteines would have formed cannot form, so the tertiary structure collapses and the active site loses its shape. **B1** the bond the mercury forms is covalent, so it does not come off, and the only recovery available is to synthesise a fresh enzyme molecule. [3]