

2024 Bi H2 Q6

Section: Metabolism and Survival

Topic: Metabolic Pathways

Question Summary

The question focuses on enzyme-controlled metabolic pathways, including types of reactions, enzyme-substrate interaction, and the regulation of pathways through feedback inhibition. Students interpret both a metabolic sequence diagram and a rate-substrate concentration graph.

Worked Solution

- (a)(i) The conversion of threonine to intermediate A is a degradation (catabolic) reaction - a larger molecule is broken down into smaller ones.

- (a)(ii) Description: When threonine binds to enzyme 1, the active site changes shape slightly to fit it better - this is induced fit.

Explanation: The induced fit holds substrate molecules more closely to the active site, lowering activation energy and increasing the rate of reaction.

- (b) High concentrations of isoleucine inhibit enzyme 1 by feedback inhibition. Isoleucine binds to an allosteric site, changing the shape of the active site so threonine can no longer bind. This prevents unnecessary synthesis of isoleucine, conserving energy and resources - an advantage to the cell.

- (c)(i) Without an inhibitor, the reaction rate levels off because all enzyme active sites are occupied - the enzyme becomes saturated.
- (c)(ii) With an inhibitor, the graph shows a lower maximum rate that cannot be overcome by higher substrate concentration. This is characteristic of non-competitive inhibition because the inhibitor affects enzyme function, not substrate binding.

Final Answer

- > (a)(i) Degradation reaction
- > (a)(ii) Induced fit alters active site to increase rate
- > (b) Feedback inhibition by isoleucine prevents overproduction
- > (c)(i) Active sites saturated at high substrate
- > (c)(ii) Non-competitive inhibition: reduced rate not restored by more substrate

Revision Tips

- Metabolic pathways are integrated sequences of enzyme-controlled reactions.
- Induced fit means enzyme shape changes slightly on substrate binding.
- Feedback inhibition regulates pathways and prevents resource waste.
- Competitive inhibitors block the active site; non-competitive inhibitors change its shape.

