2025 Bi H2 Q6

Section: Metabolism and Survival
Topic: Metabolic Pathways

Question Summary:
Threonine is converted to isoleucine through a metabolic pathway involving five enzymes. Students are asked to identify reaction type, describe and explain induced fit, explain feedback inhibition, and interpret a substrate vs. rate graph.

Worked Solution

(a)(i) The reaction catalysed by enzyme 1 is a **catabolic** reaction because it breaks down threonine into a simpler molecule (intermediate A).

(a)(ii) Description: When threonine binds, the active site of enzyme 1 **changes shape** to better fit the substrate.
Explanation: This induced fit reduces the activation energy, increasing the rate of reaction.

(b) Description: When isoleucine concentration becomes high, it binds to and inhibits **enzyme 1**, blocking the entire pathway.
Advantage: This prevents overproduction and saves the cell's energy and resources.

(c)(i) At high substrate concentrations without inhibitor, the rate levels off because **all active sites are occupied** and enzyme 1 is working at maximum capacity.

(c)(ii) The inhibitor is **non-competitive** because increasing substrate concentration does **not** restore the maximum reaction rate. The

inhibited curve never reaches the original maximum.

Final Answer:
Catabolic reaction. Active site changes shape, lowering activation energy. End-product inhibition at enzyme 1 prevents waste. Rate plateaus when all active sites are occupied. Non-competitive inhibition shown because maximum rate cannot be regained.

Revision Tips
- Catabolic reactions break molecules down.
- Induced fit lowers activation energy.
- End-product inhibition regulates metabolic pathways effectively.
- Non-competitive inhibitors reduce Vmax and cannot be overcome by extra substrate.