Advanced Biochemistry Concepts

Biochemistry · Answer Key · 8 Questions

1. Which of the following conditions would most likely lead to a significant increase in the catalytic efficiency (k_cat/K_m) of an enzyme that follows Michaelis-Menten kinetics?

A) A decrease in substrate concentration below K_m
B) A saturating concentration of a competitive inhibitor
C) A mutation that enhances the binding affinity of the enzyme for its transition state
D) An increase in the pH towards the isoelectric point of the enzyme

2. The net yield of ATP from the complete aerobic oxidation of one molecule of glucose via glycolysis, the pyruvate dehydrogenase complex, the citric acid cycle, and oxidative phosphorylation is approximately:

A) 10 ATP
B) 30-32 ATP
C) 38 ATP
D) Less than 10 ATP

3. What is the primary role of ubiquinone (Coenzyme Q) in the electron transport chain?

A) To accept electrons from Complex IV and transfer them to oxygen
B) To serve as a mobile electron carrier between Complex I or II and Complex III
C) To pump protons across the inner mitochondrial membrane
D) To directly generate ATP through substrate-level phosphorylation

4. Which of the following statements accurately describes the mechanism of allosteric regulation of enzymes?

A) Inhibitors bind covalently to the enzyme's active site, irreversibly inactivating it.
B) Activators and inhibitors bind to specific regulatory sites, causing conformational changes that affect catalytic activity.
C) Substrate binding to the active site induces a permanent change in the enzyme's three-dimensional structure.
D) Enzyme activity is solely regulated by the concentration of its substrate and product.

5. The unique property of hemoglobin that allows it to efficiently transport oxygen from the lungs to the tissues and also carry carbon dioxide back to the lungs is known as:

A) Cooperativity
B) Allosteric modulation
C) Allosteric inhibition
D) Competitive binding

6. Which enzyme is primarily responsible for the rate-limiting step in gluconeogenesis?

A) Hexokinase
B) Phosphofructokinase-1
C) Fructose-1,6-bisphosphatase
D) Pyruvate kinase

7. What is the consequence of a mutation that prevents the formation of peptide bonds during protein synthesis?

A) The ribosome will stall at the stop codon.
B) Amino acids will be added to the growing polypeptide chain without forming a backbone linkage.
C) Translation will terminate prematurely at the first tRNA binding event.
D) No functional proteins will be synthesized, leading to cell death.

8. The chemiosmotic theory, proposed by Peter Mitchell, explains ATP synthesis in mitochondria and chloroplasts based on:

A) The direct transfer of phosphate groups from substrate molecules to ADP.
B) The generation of a proton gradient across a membrane, which drives ATP synthase.
C) The cleavage of ATP into ADP and inorganic phosphate to power proton pumping.
D) The consumption of light energy to directly phosphorylate ADP.