

Advanced Biology: Bioenergetics, Respiration & Chemiosmosis



Name: _____ Date: _____

Part A: Bioenergetics Analysis. Solve each advanced cellular respiration and photosynthetic inquiry problem below.

1. During aerobic cellular respiration in eukaryotic mitochondria, what is the immediate source of energy that directly powers the rotary catalytic head of ATP Synthase?
A. Direct enzymatic cleavage of glucose in the cytoplasm
B. The flow of protons (H⁺ ions) down their electrochemical gradient from the intermembrane space into the mitochondrial matrix (Chemiosmosis)
C. Electrons directly striking ATP synthase from sunlight
D. Thermal body heat generated during muscular shivering
2. What is the primary role of molecular oxygen (O₂) in aerobic cellular respiration?
A. It acts as the final electron acceptor at Complex IV of the mitochondrial electron transport chain, forming metabolic water (H₂O)
B. It splits glucose molecules into pyruvate during anaerobic glycolysis
C. It absorbs green photons in the thylakoid lumen
D. It transports carbon dioxide out of the nucleus
3. In the light-independent reactions (Calvin Cycle) of photosynthesis occurring in plant stroma, what enzyme catalyzes the initial fixation of carbon dioxide (CO₂) onto ribulose-1,5-bisphosphate (RuBP)?
A. DNA Polymerase III
B. RuBisCO (Ribulose-1,5-bisphosphate carboxylase-oxygenase)
C. Amylase
D. Lactate Dehydrogenase

Part B: Bioenergetics Pathway Comparison Matrix. Categorize each metabolic reaction under Cellular Respiration or Photosynthesis.

Sort these items: Glycolysis -> Pyruvate Oxidation -> Krebs Cycle -> Oxidative Phosphorylation; Light-Dependent Photolysis (Thylakoids) -> Calvin Cycle Carbon Fixation (Stroma); Consumes Glucose + O₂ to produce H₂O + CO₂ + ~32 ATP (exergonic energy release); Consumes Sunlight + H₂O + CO₂ to synthesize C₆H₁₂O₆ sugar + O₂ (endergonic energy storage); Utilizes NADH and FADH₂ as high-energy electron carriers to power inner membrane cristae; Utilizes NADPH and ATP synthesized by photosystems I and II to reduce carbon compounds

Aerobic Cellular Respiration (Catabolic)	Photosynthesis (Anabolic)