Domain 1 of 4

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Overview

The Chemical and Physical Foundations of Biological Systems section tests your understanding of the physical and chemical principles that govern living systems. It accounts for approximately 30% of the total MCAT score and consists of 59 questions answered in 95 minutes.

This section integrates general chemistry, organic chemistry, biochemistry, physics, and biology to assess your ability to apply scientific principles to biological contexts.

General Chemistry Topics

- Atomic structure, electron configuration, and periodic trends
- Chemical bonding: ionic, covalent, hydrogen bonds, van der Waals forces
- Thermodynamics: enthalpy, entropy, Gibbs free energy, equilibrium
- Acid-base chemistry: pH, pKa, buffers, Henderson-Hasselbalch equation
- Electrochemistry: galvanic cells, electrolysis, Nernst equation
- Kinetics: rate laws, activation energy, Arrhenius equation, catalysis
- Solutions: colligative properties, solubility, concentration units

> ■ **Exam Tip:** Master the Henderson-Hasselbalch equation: pH = pKa + log([A■]/[HA]). It appears frequently in both chemistry and biology contexts.

Organic Chemistry Topics

- Nomenclature and functional groups: alcohols, aldehydes, ketones, carboxylic acids, amines
- Stereochemistry: chirality, R/S configuration, enantiomers, diastereomers
- Reaction mechanisms: nucleophilic substitution (SN1/SN2), elimination (E1/E2)
- Carbonyl chemistry: aldol condensation, esterification, saponification
- Spectroscopy: IR, NMR, mass spectrometry interpretation
- Amino acids: structure, properties, zwitterion form, isoelectric point

Physics Topics

- Mechanics: kinematics, Newton's laws, work, energy, momentum, torque
- Fluids: Bernoulli's equation, Pascal's law, Poiseuille's law, surface tension
- Thermodynamics: heat transfer, specific heat, ideal gas law, PV diagrams
- Electricity and magnetism: Coulomb's law, circuits, capacitors, magnetic fields
- Waves and optics: sound, light, reflection, refraction, lenses, mirrors
- Nuclear physics: radioactive decay, half-life, fission, fusion

> ■ **Exam Tip:** For physics problems, always identify the relevant equation first, then list known and unknown variables. Dimensional analysis can confirm your answer.

High-Yield Biochemistry Connections

The MCAT frequently tests how chemical principles apply to biological molecules. Focus on enzyme kinetics (Michaelis-Menten), membrane transport, and the thermodynamics of metabolic pathways.

Understanding how pH affects protein structure and enzyme activity is critical. Know how buffers maintain physiological pH and the role of the bicarbonate buffer system in blood.

Key Formulas to Memorize

- pH = -log[H■] | pOH = -log[OH■] | pH + pOH = 14
- ΔG = ΔH - TΔS | ΔG° = -RT ln(Keq)
- PV = nRT (ideal gas law)
- KE = ½mv² | PE = mgh | W = Fd cos θ
- F = qE = kq■q■/r² (Coulomb's law)
- λ = v/f (wave equation) | n■sin θ■ = n■sin θ■ (Snell's law)