

VU Learning HUB

BIO503 Quiz File

Chapter-wise Solved MCQs

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Lesson 1: Introduction to Biophysics & Interdisciplinary Applications

Q1. What is the primary definition of Biophysics as presented in the handout?

- A) The study of inorganic chemical reactions in non-living matter
- B) An interdisciplinary science applying the approaches and methods of physics to study biological systems
- C) The exclusive study of organismic population dynamics
- D) A subfield of synthetic polymer manufacturing

Q2. According to the source, what is the typical size range of protein macromolecules?

- A) 1 nanometer
- B) 5 to 10 nanometers
- C) Greater than 1,000 nanometers
- D) 100 micrometers

Q3. In what year did biophysicists discover the physical double-helix structure of DNA?

- A) 1838
- B) 1940
- C) 1953
- D) 2000

Q4. Which subfield application is correctly matched with Computer Science in biophysics research?

- A) Patch clamping and virophysics
- B) Neural networks and biomolecular databases
- C) Quantum chemistry and molecular docking
- D) Channelomics and polyketides

Answer Key

- 1: B — Biophysics is defined as an interdisciplinary science that applies physics methods to biological systems across all scales.
- 2: B — Small sugars/fatty acids are ~1 nm, proteins range from 5 to 10 nm, and starches exceed 1,000 nm.
- 3: C — James Watson and his colleague pieced together the DNA double-helix shape in 1953.
- 4: B — Computer science contributions to biophysics specifically include neural networks and biomolecular/drug databases.

Lesson 2: Biophysical Research Techniques & Imaging

Q1. What does Electrophysiology specifically measure in biological tissues and cells?

- A) Fluid movement of non-compressible liquids
- B) Voltage and current coursing through ion channel proteins
- C) Electromagnetic radiation emission during skin analysis
- D) Three-dimensional protein folding angles

Q2. Hydrodynamics is defined in the handout as the scientific study of what?

- A) Electrical resistance in cellular membranes
- B) Sound wave dispersion in aquatic ecosystems
- C) Motion of fluids, especially non-compressible liquids, under internal and external forces
- D) X-ray diffraction patterns in protein crystals

Q3. Which biophysical approach uses computer simulations to analyze cellular subsystems such as metabolic networks and signal transduction pathways?

- A) Mass spectrometry
- B) Confocal fluorescence microscopy
- C) Modeling & Simulation
- D) Atomic force microscopy

Q4. What is a major advantage of utilizing Fluorescence in biophysical research?

- A) It breaks peptide bonds for mass measurement
- B) It offers a non-destructive way to track biological molecules and analyze macromolecular interactions
- C) It permanently alters the pH of cellular compartments
- D) It converts non-compressible liquids into solid crystals

Answer Key

- 1: B — Electrophysiology focuses on measuring voltage and current passing through tissues via ion channels.
- 2: C — Hydrodynamics is the scientific study of fluid motion, specifically non-compressible liquids under forces.
- 3: C — Modeling and simulation uses computer models to visualize complex cellular pathways and networks.
- 4: B — Fluorescence provides a non-destructive method for tracking biomolecules and examining protein/nucleic acid interactions.

Lesson 3: Structure and Comparison of DNA and RNA

Q1. What specific chemical feature distinguishes the ribose sugar in RNA from the deoxyribose sugar in DNA?

- A) Ribose has one additional -OH group attached to the 2' carbon
- B) Deoxyribose has an extra methyl group on its ring
- C) Ribose lacks a phosphate group on its backbone
- D) Deoxyribose contains double nitrogen rings

Q2. How does the nitrogenous base Uracil in RNA differ structurally from Thymine in DNA?

- A) Uracil contains an extra hydroxyl group
- B) Uracil lacks a methyl group on its ring
- C) Uracil has two additional carbon rings
- D) Uracil forms triple hydrogen bonds with Cytosine

Q3. What helical structural forms are typically assumed by DNA and RNA molecules respectively?

- A) DNA forms an A-form single strand; RNA forms a B-form double helix
- B) DNA forms a B-form double helix; RNA usually forms an A-form single helix
- C) Both DNA and RNA form Z-form triple helices
- D) DNA forms a random coil; RNA forms a triple-pass barrel

Q4. Why is RNA less chemically stable under alkaline conditions compared to DNA?

- A) RNA contains C-H bonds that break down easily
- B) The O-H bond in ribose makes RNA more reactive and susceptible to alkaline degradation
- C) Small grooves in RNA allow rapid enzyme destruction
- D) RNA is completely resistant to ultraviolet damage

Answer Key

- 1: A — Ribose in RNA possesses an extra -OH group at the 2' carbon position compared to deoxyribose in DNA.
- 2: B — Uracil differs from thymine because it lacks a methyl group on its ring.
- 3: B — DNA typically adopts a B-form double helix, whereas RNA forms an A-form single-strand helix.
- 4: B — The additional O-H group in ribose increases RNA's reactivity, rendering it unstable in alkaline environments.

Lesson 4: Chemistry of Amino Acids & Protein Structure

Q1. Who coined the term "protein" in 1838, and what was its Greek origin meaning?

- A) James Watson; meaning "double thread"
- B) Jöns Jacob Berzelius; derived from proteios, meaning "holding first place"
- C) Ivan Regen; meaning "airborne acoustic"
- D) Gregor Mendel; meaning "unit of inheritance"

Q2. What is an amino acid called when it exists at its isoelectric point (pI) with a net zero electrical charge?

- A) Anion
- B) Cation
- C) Zwitterion
- D) Polypeptide

Q3. Which statement accurately describes secondary structure elements in proteins?

- A) The alpha-helix is a right-handed coiled strand, and antiparallel beta-sheets are more stable due to aligned hydrogen bonds
- B) The beta-sheet is always a left-handed triple helix
- C) Secondary structure is defined solely by covalent disulfide bonds
- D) Secondary structure represents the overall 3D subunit complex

Q4. How many standard L-alpha-amino acids are used by cells for protein construction, and how many are essential for humans?

- A) 10 total; 5 essential
- B) 20 total; 10 essential
- C) 30 total; 15 essential
- D) 50 total; 20 essential

Answer Key

- 1: B — Berzelius coined "protein" in 1838 from Greek proteios, meaning "holding first place".
- 2: C — An amino acid form carrying a net zero charge at its isoelectric point is termed a zwitterion.
- 3: A — Secondary structure includes right-handed alpha-helices and parallel/antiparallel beta-sheets stabilized by hydrogen bonds.
- 4: B — Cells utilize 20 standard amino acids, 10 of which cannot be synthesized by humans and must come from the diet.

Lesson 5: Cellular Bioenergetics & Thermodynamics

Q1. How do living cells maintain their highly ordered internal state with low entropy?

- A) By dissipating 100% of energy as light

- B) Through constant energy input to counteract natural disorder
- C) By eliminating all cellular respiration
- D) By storing excess amino acids indefinitely

Q2. During photosynthesis, what molecule stores the converted solar chemical energy?

- A) Pyruvate
- B) Lactase
- C) Glucose
- D) Cholesterol

Q3. What energy-carrying molecule is produced during cellular respiration to directly power cell functions like mitosis and DNA replication?

- A) RNA polymerase
- B) ATP
- C) Porphyrin
- D) Phospholipid

Q4. Why are there fewer consumers than producers in an ecosystem according to thermodynamic principles?

- A) Consumers lose the ability to perform endocytosis
- B) Energy is lost as heat during metabolic processes, leaving less available energy at higher trophic levels
- C) Producers absorb all available ATP from animal tissues
- D) Consumers store excess entropy in plant walls

Answer Key

- 1: B — Cells are highly ordered (low entropy) and require constant energy input to maintain that state.
- 2: C — Absorbed light energy is converted and stored as chemical energy in glucose molecules.
- 3: B — Respiration breaks down glucose to produce ATP, which powers vital cellular work.
- 4: B — Metabolic energy loss as heat at lower trophic levels reduces the total energy available to support higher-level consumers.

Lesson 6: Plasma Membrane Composition & Fluidity

Q1. In a typical human cell, what percentage of the plasma membrane mass is accounted for by proteins, lipids, and carbohydrates respectively?

- A) 30% protein, 30% lipid, 40% carbohydrate
- B) 50% protein, 40% lipid, 10% carbohydrate
- C) 70% protein, 20% lipid, 10% carbohydrate
- D) 40% protein, 50% lipid, 10% carbohydrate

Q2. What term describes a phospholipid molecule having both a hydrophilic head and hydrophobic tails?

- A) Isomorphic
- B) Amphipathic
- C) Zwitterionic
- D) Denatured

Q3. How does cholesterol regulate plasma membrane fluidity at low temperatures?

- A) It breaks phosphate bonds to create large pores
- B) It increases fluidity by preventing phospholipids from packing tightly together
- C) It dissolves integral proteins into the cytosol
- D) It attaches carbohydrate chains to the extracellular face

Q4. What are integral membrane proteins called when they extend all the way across the phospholipid bilayer?

- A) Peripheral proteins
- B) Glycolipids
- C) Transmembrane proteins
- D) Micelles

Answer Key

- 1: B — Mass composition of a typical human cell membrane is ~50% protein, ~40% lipid, and ~10% carbohydrate.
- 2: B — Phospholipids are amphipathic because they contain both water-loving heads and water-fearing tails.
- 3: B — At cool temperatures, cholesterol prevents tight packing of fatty acid tails to maintain membrane fluidity.
- 4: C — Integral proteins spanning completely across the membrane bilayer are called transmembrane proteins.

Lesson 7: Molecular Separation & Characterization Methods

Q1. In Gel Filtration (Size Exclusion) Chromatography, which molecules elute from the column first?

- A) Smallest molecules because they enter all bead pores
- B) Charged molecules that bind tightly to the matrix
- C) Large molecules because they are excluded from the porous beads
- D) Thermally unstable volatile gases

Q2. For which type of chemical compounds is High Performance Liquid Chromatography (HPLC) especially suitable?

- A) Simple inorganic gases that volatilize instantly
- B) Non-polar volatile solvents
- C) Compounds that are thermally unstable, not easily volatilized, or have high molecular weights
- D) Pure metallic elements

Q3. How is "Specific Activity" calculated during enzyme purification steps?

- A) By multiplying total protein volume by fraction yield
- B) By dividing total enzyme activity by total protein quantity
- C) By subtracting crude extract activity from final yield
- D) By measuring the pH change at the isoelectric point

Q4. What initial pH range is used when loading amino acids onto a strong acidic cation exchanger to ensure complete binding?

- A) pH 1 - 2
- B) pH 7 - 8
- C) pH 10 - 12
- D) pH 14

Answer Key

- 1: C — Large molecules cannot enter bead pores, so they bypass the matrix and elute rapidly.
- 2: C — HPLC is ideal for separating compounds that are high molecular weight, thermally unstable, or non-volatile.
- 3: B — Specific activity is obtained by dividing total activity by total protein content.
- 4: A — Samples are loaded at pH 1–2 to guarantee complete binding of all amino acids to the cation exchange column.

Lesson 8: Advanced Biophysical Phenomena

Q1. What pathological condition results from the incorrect molecular self-assembly of misfolded proteins into insoluble fibers?

- A) Lactose intolerance
- B) Infectious prion-related neurodegenerative diseases (amyloid fibers)
- C) Disruption of the phospholipid bilayer
- D) Loss of UV resistance in RNA

Q2. Who established Bioacoustics as a scientific discipline by studying insect stridulation and discovering the function of the tympanal organ?

- A) Jöns Jacob Berzelius
- B) Francis Crick
- C) Ivan Regen
- D) OpenStax

Q3. What specific region on an enzyme captures the substrate molecule (such as maltose) to catalyze a reaction?

- A) Zwitterion site
- B) Active site
- C) C-terminus tail
- D) Micelle pore

Q4. In a DNA Microarray (biochip), what are the microscopic DNA sequence spots attached to the surface known as?

- A) Antigens
- B) Probes (reporters or oligos)
- C) Liposomes
- D) Trophic levels

Answer Key

- 1: B — Incorrect self-assembly of misfolded proteins into insoluble amyloid fibers causes prion neurodegenerative diseases.
- 2: C — Ivan Regen founded bioacoustics through insect sound experiments and discovered the tympanal organ's role.
- 3: B — Enzymes capture and catalyze substrate molecules at their specific active sites.
- 4: B — Microarray DNA spots contain picomoles of specific sequences referred to as probes or reporters.

End of Quiz

BIO503 — 32 solved MCQs
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