

Biochemistry Review

A. Top 10

1. All living matter made up of CHONPS
2. Bonds
 - a. covalent bonds are strong
 - b. hydrogen bonds are weak
 - c. polar molecules vs. non-polar molecules
 - d. reaction with water (cytoplasm & extracellular solution) vs. cell membrane
3. Reactions of life
 - a. dehydration synthesis
 - releases water
 - synthesis: builds covalent bonds
 - anabolic, endergonic
 - b. hydrolysis
 - uses water
 - digestion: break covalent bonds
 - catabolic, exergonic
4. Water
 - a. polar molecule leads to special properties
 - cohesion, adhesion, high specific heat, less dense as solid
5. Macromolecules
 - a. carbohydrates
 - sugar monomer
 - energy, structure (cell wall, chitin)
 - b. lipids
 - phospholipids (cell membrane)
 - energy storage
 - steroid hormones
 - c. proteins (amino acids)
 - amino acid monomer
 - 4 levels of structure
 - bonding at each level: covalent, H bonds, hydrophobic interactions, van der Waals forces, ionic bonds, disulfide bridges
 - many functions!: enzymes, structure, regulatory molecules
 - d. nucleic acids
 - nucleotide monomers
 - information storage
6. Enzyme function
 - a. proteins & RNA
 - b. bind to substrate
 - c. speed rate of reactions: reduce activation energy
 - d. induced fit (lock & key)
 - e. affected by temperature, pH, salinity, concentration of substrate & enzyme

B. Sample Multiple Choice Questions

- Which of the following is an example of a hydrogen bond?
 - The peptide bond between amino acids in a protein
 - The bond between an oxygen atom and a hydrogen in the carboxyl group of a fatty acid.
 - The bond between Na^+ and Cl^- in salt
 - The attraction between a hydrogen of one water molecule and the oxygen of another water molecule.
 - The bond between carbon and hydrogen in methane
- A feature of organic compounds NOT found in inorganic compounds is the presence of
 - ionizing chemical groups
 - electrons
 - carbon atoms covalently bonded to each other
 - oxygen
 - hydrogen bonds
- The bonding of two amino acid molecules to form a larger molecule requires
 - the release of a water molecule
 - the release of a carbon dioxide molecule
 - the addition of a nitrogen atom
 - the addition of a water molecule
 - an increase in activation energy
- Which of the following best characterizes the reaction represented below
$$\text{A} + \text{B} + \text{energy} \rightarrow \text{AB}$$
 - hydrolysis
 - catabolism
 - oxidation-reduction
 - exergonic reaction
 - endergonic reaction
- Which of the following can be used to determine the rate of enzyme-catalyzed reactions
 - rate of disappearance of the enzyme
 - rate of disappearance of the substrate
 - rate of disappearance of the product
 - change in volume of the solution
 - increase in activation energy
- Butterflies of the genus *Colis* live in the Rocky Mountains, where they experience a wide range of temperatures. Different variants of a particular glycolytic enzyme in the flight muscles are optimally active at different temperatures. Within one population, some individual butterflies fly most effectively at 29°C , while others fly most effectively at 40°C . Still others can be equally active at both temperatures. Which of the following claims is most consistent with the observed butterfly behavior?
 - Butterflies that express two variants of the enzyme are active over a greater range of temperature.
 - Butterflies that are active over a wide range of temperatures produce a greater amount of the enzyme.
 - Temperature has little effect on the activity of butterflies.
 - Butterflies that are active at warmer temperatures produce more offspring.

C. Sample Free Response Questions

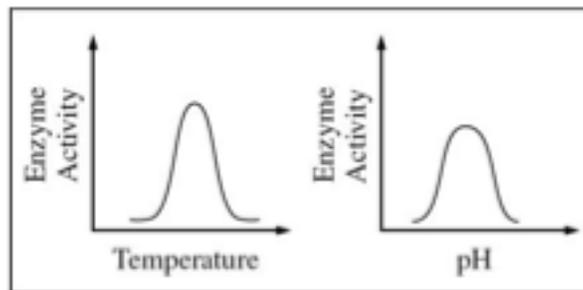
1. Water is important for all living organisms. The functions of water are directly related to its physical properties.

- a. Describe how the properties of water contribute to TWO of the following
 - transpiration **old**
 - thermoregulation in endotherms - **sweating: Water has a high heat of vaporization . It takes a "great deal" of energy for water molecules to evaporate. As water evaporates off the surface of the skin it "removes" heat from the body. The body heat causes the evaporation of water**
 - plasma membrane structure - **polarity of water and nonpolarity of the tails of the phospholipids - causes phospholipids to form a bilayer with the tails on the inside of the membrane**
- b. Water serves as a reactant and a product in the carbon cycle. Discuss the role of water in the carbon cycle. **The water cycles through cellular respiration and photosynthesis**
- c. Discuss the impact of one human activity on the water cycle. **Pollution, eutrophication, climate change - warming causes changes to weather patterns**

2. Proteins — large complex molecules — are building blocks of all living organisms. Discuss the following in relation to proteins.

- a. the chemical composition and levels of structure of proteins - **describe primary, secondary, tertiary and quaternary structures**
- b. the roles of DNA and RNA in protein synthesis - **DNA contains the code for make proteins (genes), mRNA carries the code to ribosomes, tRNA brings amino acids to the ribosome and r**
- c. the roles of proteins in membrane structure and transport of molecules across the membrane **describe the fluid mosaic model, the characteristics of amino acids at the different regions in the membrane (portions touching the heads and the portions touching the tails). Describe the function of channel proteins (passive diffusion), and transport proteins (active transport) Aquaporin would be a good example**

3. The effects of pH and temperature were studied for an enzyme-catalyzed reaction. The following results were obtained.



- a. How do (1) temperature and (2) pH affect the activity of this enzyme? In your answer, include a discussion of the relationship between the structure and the function of this enzyme, as well as a discussion of how structure and function of enzymes are affected by temperature and pH.
- b. Describe a controlled experiment that could have produced the data shown for either temperature or pH. Be sure to state the hypothesis that was tested here.

4. The physical structure of a protein often reflects and affects its function.

- a. Describe THREE types of chemical bonds/interactions found in proteins. For each type, describe the role in determining protein structure. **Primary structure = peptide bonds (describe); secondary structure (hydrogen bonds); tertiary (ionic, covalent, hydrophobic interactions)**
- b. Discuss how the structure of a protein affects the function of TWO of the following.

- muscle contraction **old curriculum**
- regulation of enzyme activity **active site and substrate shape**
- cell signaling **receptor and hormone shape**

c. Abnormal hemoglobin is the identifying characteristic of sickle cell anemia. Explain the genetic basis of abnormal hemoglobin. Explain why the sickle cell allele is selected for in certain areas of the world. **Sickle cell is a point mutation - changing one amino acid. Causes the hemoglobin to produce sickle shaped cells. These cells are less likely to be infected with malaria. Heterozygous people have an advantage in areas where malaria is present because they have a mix of normal and sickle shaped cells.**