Biochem Review

Ch. 2

1. How do the properties of a compound like H_2O or NaCl illustrate the concept of emergent properties?
2. How common are the elements that living systems are made out of?
3. Explain the relationship between matter and energy.
4. Why do atoms bond?
5. What is the cause of molecular polarity?
6. How does the type of bonds present in a substance influence the chemical and physical properties of that substance?
7. Why are radioactive elements useful for the study of biological systems?

Ch. 3

1. Why are living things mostly made of water?
2. Draw a water molecule and indicate its polarity.
3. Explain how the structure of water molecules account for each of the following properties:
    a. Cohesion
    b. Adhesion
    c. High Specific Heat
    d. Floating Ice
    e. Good Solvent Properties
    f. Dissociation of water molecules
4. Explain 1 way that each of the above properties are useful for living systems.
5. Explain the relationship between the dissociation of water and the pH of a particular aqueous solution.

Ch. 4

1. Why is carbon central to the structure of all biological molecules?
2. Explain the concept of an isomer. As the number of carbon atoms in a molecule increases, what happens to the number of possible isomers of that molecule?
3. Draw each of the following functional groups:
    a. hydroxyl
    b. carbonyl (ketone)
    c. carbonyl (aldehyde)
    d. carboxyl
    e. amino
    f. sulfhydryl
    g. methyl
    h. phosphate
4. Why are molecules that contain carboxyl groups acidic?
5. Why are molecules that contain amino groups basic?

6. How large a change to the structure of an organic molecule has to be made, for that molecule to have a major difference in its effect on a living system?

Ch. 5

1. How are macromolecule polymers assembled from monomers? How are they broken down?
2. How can you tell a biological molecule is a carbohydrate?
3. Explain the relationship between monosaccharides, disaccharides, and polysaccharides.
4. Why are starch and glycogen useful as energy storage molecules, while cellulose is useful for structure and support? Why isn't cellulose easily broken down?
5. How do herbivores solve the problem of cellulose digestion?
6. How can you tell a biological molecule is a lipid?
7. Chemically, what is the difference between a saturated fat and an unsaturated fat? How does this difference affect the properties of the molecules?
8. How are triglycerides, phospholipids, and steroids similar? How do they differ?
9. Why are proteins the most complex biological molecules?
10. Draw the structure of a general amino acid. Label the carboxyl group, the amino group, and the variable ('R') group.
11. Draw the formation of a peptide bond between two amino acids.
12. How does the structure of the 'R' group affect the properties of a particular amino acid?
13. Define each of the following levels of protein structure and explain the bonds that contribute to them:
    a. Primary
    b. Secondary
    c. Tertiary
    d. Quaternary
14. How can the structure of a protein be changed ("denatured")?
15. Draw a nucleotide. Label the phosphate, sugar, and nitrogenous base.
16. Explain the three major structural differences between RNA and DNA.

Ch. 8

1. State the first law of thermodynamics and explain how living systems comply with this law. Provide one real-life example to support your explanation.
2. State the second law of thermodynamics and explain how living systems comply with this law. Provide one real-life example to support your explanation.
3. How is the maintenance of a highly ordered living system possible, given the tendency of the Universe to tend toward increasing disorder? Provide an explanation for the order of an organism, AND an explanation for the order of successive generations of organisms.
4. Is a living system ever in equilibrium with it's surroundings? Explain why or why not, and when equilibrium occurs (if ever).
5. Explain the energetic advantage of coupling exergonic reactions to endergonic reactions. Which reaction must be greater in terms of energetic magnitude?
6. Organisms are endergonic systems. What are the exergonic reactions that provide living systems with energy (give two examples).

7. If the breaking of bonds requires an input of energy (which it always does), how is it possible that some chemical reactions (like the burning of gasoline, for instance) can release energy into the environment?
8. The relationships between the following pairs of words:
    1. Anabolic and Catabolic
    2. Exergonic and Endergonic
    3. Energy and Free Energy
    4. Open and closed system
9. The energetic relationship between an organism and it's surroundings.
10. Why organisms need to release energy in a series of controlled steps
11. The structure of an ATP molecule.
12. How an ATP molecule is converted into an ADP molecule and how that process produces energy.
13. How do enzymes catalyze chemical reactions (don't just say "they lower the activation energy", give me specific mechanisms).
14. Explain the significance of reaction coupling in living systems. How is it used, and what does it allow living systems to do that they would not be able to do otherwise?
15. Why does the activation energy of many reactions in living systems need to be reduced for living systems to function?
16. Compare the "lock-and-key" model of enzyme function with the "induced fit" model of enzyme function.
17. Explain how each of the following affect enzyme structure and function:
    a. Substrate concentration
    b. temperature
    c. pH
    d. salt concentration
    e. cofactors and coenzymes
18. Explain the difference between a competitive inhibitor and a non-competitive inhibitor.
19. How is feedback regulation of enzyme reaction related to allosteric regulation of enzyme function?
20. Why enzymes are classified as catalysts.
21. Specific examples of enzymes used in all major metabolic pathways in living systems, and the reactions that they catalyze.