

Physics and Chemistry for Biologists -- A Review

Reading assignment: Campbell Chs. 2 through 4 (Ch. 4 should be read as an overview only).

This is a large reading assignment but one that is hopefully all review. In other words, the vast majority of students are familiar with nearly all of these concepts on arrival at college. Thus, so we can concentrate on biology, we will go over this material outside of class at two times and places that will be set up the first day of class. Accordingly, you should look this material over immediately.

Focus especially on the concepts of bonding, bond polarity, the properties of water

Ch. 2

1. Terms (really obvious ones like atom are omitted):

trace element	polar and non-polar bond
atomic number	ionic bond
atomic weight	cation
isotope	anion
potential energy	"hydrogen bond"
electron shell and energy level	Van der Waals interaction
valence electrons, valence shell	reactant
covalent bond	product
electronegative	chemical equilibrium
electropositive	

2. Explain what is meant by the "emergent properties" of a compound.
3. Describe the relationship between an electron's position relative to the nucleus and the potential energy it contains. Are all positions possible for an electron (not covered in the text).
4. Why do chemical properties depend largely on the number of electrons in a valence shell.
5. How many electrons can a given orbital contain? What is the significance of outer orbitals such the p orbitals to the shapes of compounds?
6. What is the number of electrons in a complete outermost shell for any element with an atomic number greater than 2? Does element number 7 (N) have a complete outer shell? Explain. Know the electron configurations for the following elements: H, He, C, N, O, F, K. How many valence electrons in Na, Cl, Mg, S and P?

7. Distinguish between the following: molecule vs. compound; structural formula molecular formula.

8. How many electrons are shared in a single covalent bond? Forming a covalent bond results in how many electrons in each atom's outer shell? (don't give a number here since there are two that are appropriate).

9. *Important:* What causes covalent bonds with a polar character? Which of the following covalent bonds have a distinct polar character? When polar, indicate which end is + and which is - . :

C -- C O -- H C == O O == O C -- N N -- H

10. Why can ionic and non-polar covalent bonds be thought of as opposite poles on a continuum?

11. In order for an H bond to form, do you need substances with polar or non-polar bonds?

12. If H bonds and Van der Waals forces are so weak, why do they matter in biology.

13. Why does a molecule's shape matter so much?

looking ahead: Could you say the same thing about charge arrangement (polar and ionic regions or a molecule? Explain.

14. What is true of the forward and reverse reaction rates at chemical equilibrium? Are the concentrations of product and reactant equal at equilibrium? What is the potential energy state of a chemical reaction at equilibrium compared to when it is not at equilibrium?

If you want more, there is an excellent set of questions at the end of both Chapters.

Chapter 3

1. Terms:

surface tension	solution
adhesion	hydrophilic
cohesion	hydrophobic
specific heat	mol
heat of vaporization	molarity (M)
solute	acid
solvent	base

2. Energy released from a reaction or process can take many forms. Why is it so common to measure the energy as heat?

3. Why is water so polar?

4. What causes a material to be hydrophilic?

5. Name the two commonly used measurement units for energy and be able to define each.

6. See pp. 47-48. Pure water has a pH of 7. It is termed neutral with respect to pH . Are there H^+ ions in pure water and if so, what is their concentration? Are there $[OH^-]$ molecules in pure water and if so what is their concentration? If you answered yes to both of these questions (as you should have), please explain why OH^- and H^+ , which will react to each other, coexist in a solution.

7. What is the difference between a weak and strong acid?

8. If in a solution the $[H^+] = 0.001$ M and the concentration of a base such as bicarbonate (HCO_3^-) is 0.1, what is the pH ? (Hint: keep you mind on the definition of pH).

9. Here is a phosphate buffer:



Which species is the acid, the base, and which determines the pH ?

Whew!!