

CHEM106 PS-2: **Due at the beginning of class**

1. Draw Lewis structures for the given acids and their respective conjugate bases:
 - a. Phosphoric acid
 - b. Carbonic acid
 - c. Butanoic acid
2. Use the Henderson-Hasselbalch equation to determine the relative amounts of acetic acid and acetate ion at each of the given pH's:
 - a. pH = 1.4
 - b. pH = 5.6
3. Look up the boiling points for n-hexane, n-octane, n-decane, n-dodecane and clearly explain using diagrams and discussions why they are different.
4. n-Octane and 2,2,4 trimethyl pentane both have the same molecular formula (C_8H_{18}). Find the boiling points for each of these substances; then draw the Lewis structure for each. Finally, clearly explain and use a diagram to describe the scientific basis for their difference in boiling points.
5. Acetone (CH_3COCH_3) is used in nail polish removers. Draw Lewis structures of two acetone molecules in the orientation that maximizes their attraction for one another. Clearly label your diagram by effectively illustrating this interaction.
6. Define what is meant by effective nuclear charge (ENC). Determine the effective nuclear charge for the P atom and clearly diagram how this is determined.
7. Compare the electronegativity of P and Si and use Coulomb's Law to effectively explain the difference.
8. Draw the structure for $CH_2ClCHOHCOOH$ showing bonds, lone pairs, and significant partial charges.
9. Compare the boiling points of H_2S , H_2Se , H_2Te and H_2O . Use the periodic table to clearly explain the underlying reason for these differences. Be very specific.
10. Write a chemical equation for the boiling of liquid propane; without doing any calculations, predict the signs of the enthalpy and entropy changes for this process. Also predict how the sign of the change in Gibbs Free Energy varies over the entire range of possible temperatures and draw a diagram that clearly illustrates this. Predict the temperature conditions (if any) under which this would spontaneously occur.
11. Use Coulomb's Law to compare the hydration energies of sodium, potassium, and calcium ions respectively. Draw appropriate and clearly labeled diagrams to fully support your predictions. Include in your answer what is specifically meant by hydration energies.
12. If two molecules are held together via hydrogen bonding with a strength of 12 kJ/mole, predict the fraction of molecules with sufficient kinetic energy to break these hydrogen bonds; assume a physiological temperature of 98.6°F.
13. Clearly label each hydrogen bond donor (HBD) and hydrogen bond acceptor (HBA) in prozac.

