Due: Friday, 28-March-2008 before you leave for break; class-time would be nice. All work is to be your own.

1) B-strain can occur in amines to lower their basicity. Will B-strain inhibit or enhance the acidic behavior of boranes?

2) Phosphorous acid can exist as either of two tautomers,

\[
\begin{align*}
\text{P} & \quad \text{OH} \\
\text{OH} & \quad \text{or} \quad \text{H} \\
& \quad \text{P} \quad \text{OH} \\
& \quad \text{OH}
\end{align*}
\]

From the pKₐ of phosphorous acid (1.8) assign a structure to the form of phosphorous acid in aqueous solution. The pKₐ of hypophosphorous acid, H₃PO₂, is 2.00. Assign a reasonable structure. (Hint: Chapter 18 might help.)

3a) Acid rain is defined as any precipitation with pH < 5.6. Why 5.6; why not 7.0?

b) Some ill effects of acid rain come not from the low pH, per se, but from the toxicity of metal ions. Explain.

4) Around the time that Pauling was developing his equation relating the pKₐ of oxoacids to the number of non-hydrogen-bearing oxygens in the oxoacid, another chemist (J.E. Ricci) was developing a similar equation for oxoacids, HₘXₙOₙ, which is:

\[
pK_a = 8 - 9f + 4(n-m)
\]

in which \(f\) represents the formal charge on the central atom (assuming that no oxygen-central atom bond has multiple bond character), and \((n-m)\) represents the number of oxygens not bonded to hydrogen. Using this equation, calculate the pKₐs for each of the following acids:

a) H₂SeO₄
b) H₂SeO₃
c) HNO₂
d) H₃BO₃

5) Water is a weak acid, but most hydrocarbons are usually considered to have virtually no acidity whatsoever. However, in the gas phase, C₆H₅CH₃ is \(10^{12}\) stronger as an acid than H₂O. Discuss the particular molecular properties that cause the gas-phase values to be different from solution data and to differ so much between these two species.
6) Calculate the potential for the oxidation of UO$_2$ to UO$_2^{2+}$ in acid solution from the following information:

\[
\begin{align*}
\text{UO}_2^{+} + e^- &\rightarrow \text{UO}_2 & E^o = 0.66 \text{ V} \\
\text{UO}_2^{2+} + e^- &\rightarrow \text{UO}_2^+ & E^o = 0.16 \text{ V}.
\end{align*}
\]

7) The stability constant, K, for Au(CN)$_2^-$ is defined as \[ \frac{[\text{Au(CN)}^-_2]}{[\text{Au}][\text{CN}^{-}]} \].

a) From the $E^o$ of +0.60 V for Au$^+$ + 2 CN$^-$ $\rightarrow$ Au(CN)$_2^-$, estimate K
b) Qualitatively describe why this complex is so stable.

8) Calcium oxide is a basic anhydride with respect to aqueous acid-base chemistry.
   a) Write the formula for the equivalent species in NH$_3$(l)
   b) Write the equation for NH$_3$ solution that corresponds to the aqueous solution equation CaO + H$_2$O $\rightarrow$ Ca(OH)$_2$

9) Give names for the following compounds; in those cases where stereochemistry is appropriate to specify, please give the proper description:

a) [Fe(NH$_3$)(CN)$_5$]$^{2-}$

b) [CoCl$_4$]$^{2-}$

c)

d)

e) [Co(en)$_3$][PtCl$_6$]