1. (6 points) Given the following average bond dissociation energies and enthalpy, calculate $\Delta H_{\text{RXN}}$ and $\Delta H_{\text{N}}$ for the combustion of benzene, $C_6H_6$ (l).

$$2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l)$$

$$\Delta H = \frac{1}{2}(607 + 10(347) + 10(413) + 15(498)) - (24(805) + 12(464)) = -3369 \text{ kJ}$$

$$-9.2 \times 10^{-3} \text{ mol}$$

2. (3 points) Calcium fluoride is a sparingly soluble salt (ppt) $K_{sp} = 5.3 \times 10^{-11}$. In which of the following solutions would you predict the salt to be most soluble? Explain your choice.

(a) de-ionized water  (b) 0.010M sodium nitrate  (c) 0.010M sodium fluoride

(b) has the highest ionic strength due to a common ion.

3. (6 points) A solution with a pH of 4.5 has a total acetate/acetic acid concentration of 0.050M. Determine the $[HC_2H_3O_2^+]$, $[C_2H_3O_2^-]$ and $[OH^-]$ of the solution. $pK_a = 4.74$

$$pH = pK_a + \log \left( \frac{[HC_2H_3O_2^+]}{[C_2H_3O_2^-]} \right)$$

$$\frac{[C_2H_3O_2^-]}{[HC_2H_3O_2]} = 0.575$$

$$[C_2H_3O_2^-] = 0.575/[HC_2H_3O_2]$$

$$[C_2H_3O_2^-] + [CH_3CO_2^-] = 0.050$$

$$0.575[HC_2H_3O_2] + [CH_2H_3O_2^-] = 0.050$$

$$[HC_2H_3O_2] = \frac{0.050}{1 + 0.575} = 0.32 \text{ M}$$

$$[CH_3CO_2^-] = \frac{0.050}{1} = 0.32$$

$$[OH^-] = 10^{-10}$$