CE 326 Principles of Environmental Engineering
Water Chemistry Calculations

A water sample was analyzed and was found to have the following constituents:

Ca^{+2}, mg/L	135	HCO_3^-, mg/L	340
Mg^{+2}, mg/L	36	SO_4^{-2}, mg/L	122
Na^+, mg/L	11.6	Cl^-, mg/L	56
K^+, mg/L	4.2	CO_3^{-2}, mg/L	1.8
Fe^{+2}, mg/L	9.6		
Mn^{+2}, mg/L	0.8	Temperature	25°C

1. Calculate each of the concentrations as mg/L as $CaCO_3$.
2. Calculate the hydrogen ion concentration:
   a. as moles/L.
   b. as mg/L.
   c. as mg/L as $CaCO_3$.
   d. as pH.
3. Calculate the hydroxide ion concentration:
   a. as moles/L.
   b. as mg/L.
   c. as mg/L as $CaCO_3$.
   d. as pOH.
4. Calculate the concentration of CO_2 as mg/L as $CaCO_3$ (use the equilibrium equations for the carbonate system and assume that H_2CO_3 concentration is equal to the CO_2 concentration).
5. Calculate the alkalinity (exactly).
6. Calculate the total, carbonate, and non-carbonate hardness of the water (include contributions made by iron and manganese).
7. How many mL of 0.02N H_2SO_4 would be required to neutralize the bicarbonate alkalinity in a 50 mL sample?
8. Draw a bar chart for the water (see pages 238-239 for an example).
9. Based on the solubility product for calcium carbonate, how much calcium (mg/L as $CaCO_3$) should be soluble in this water? Is the water under-saturated or over-saturated with respect to calcium?
10. Based on the solubility product for magnesium hydroxide, how much magnesium (mg/L as $CaCO_3$) should be soluble in this water? Is the water under-saturated or over-saturated with respect to magnesium?