**Problem 1.** Consider a treated drinking water that contains 31 μg/L chloroform (CHCl3), 11 μg/L Bromoform (CHBr3), 8 μg/L dichloroacetic acid (Cl2HC-COOH), and 19 μg/L trichloroacetic acid (Cl3C-COOH), the major disinfection by-products (DBPs). What is the total concentration of DBPs, expressed in mg/L as Cl-? Molecular weights (g/mole): C = 12; O = 16; H = 1; Cl- = 35.5; Br- = 79.9.

**Problem 2**. A solution contains 8μg/L lead (Pb). Express this concentration as moles/L, mass fraction (φ), ppm, ppt, and ppb. Assume the solution has a density of 1 g/cm3. MW for Pb = 207 g/mole.

**Problem 3.** 1-Liter water contains 40 mg of calcium (Ca2+) which reacts with carbonate (CO32-) to form calcium carbonate (CaCO3(s)) according to the following reaction:

Ca2+ + CO32- → CaCO3(s).

Assume the above reaction is complete; calculate how many milligrams of carbonate will be needed to react with all calcium ions in water. Molecular weights (g/mole): Ca = 40; C = 12; O = 16.

**Problem 4.** Find the normality of the following solutions:

1. 36.5 mg HCl/liter, with respect to the reaction

HCl + NaOH ↔ NaCl + H2O

1. 49 mg H3PO4/liter, with respect to the reaction

H3PO4 ↔ 2H+ + HPO42-

1. 45 mg CO32-/liter, with respect to the reaction

CO32- + H2O ↔ HCO3- + OH-

1. 45 mg/L CO32-/liter, with respect to the reaction

CO32- + 2H+ ↔ H2CO3

**Problem 5.** 50 ml of 10-3 M ferrous iron (Fe2+) solution will be mixed with 80 ml of another 100 g/L Fe2+ solution. Calculate the mass (C), mole (M), and normal (N) concentration of the mixed solution as mg/L, mole/L, and eq.mole/L, respectively. MW for Fe2+ = 56 g/mole.

**Problem 6.** 50 ml of 10-3 mole/L H2SO4 is added to 150 ml of 10-3 M NaOH solution and following reaction take place:

H2SO4 + NaOH ↔ SO42- + Na+ + H2O + H+

Assume that the reaction is complete, what will be the final pH of the mixed solution.

**Problem 7.** Silver ions (Ag+) react with chloride ions (Cl-) to form silver chloride salt (AgCl) according to a reaction given below:

Ag+ + Cl- → AgCl(s)

Now, assume that you have a 1-liter sample which contains 140 mg/L of chloride ions and you want all your chloride ions react with silver ions with respect to reaction given above. How many grams of silver sulfate (Ag2SO4(s)) do you need to add to your sample for the complete reaction of chloride with silver ions? Molecular weights (g/mole) Ag+ = 108; Cl- = 35.5; SO42- = 96

**Problem 8.** A 0.1 N potassium permanganate (KMnO4) solution will be prepared based on the following redox reaction:

MnO4- → Mn2+ (this half redox reaction should be balanced)

Calculate how many grams of potassium permanganate salt should be used to prepared 0.05 N KMnO4 of 100 ml. Molecular weights (g/mole): Mn = 55; K = 39; O =16.

**Problem 9.** The concentration of mercury ions in a solution is measured around 100 mg/L. Assume we desire to form a complex based on a reaction between mercury (Hg2+) and chloride ions (Cl-):

Hg2+ + 4Cl- → HgCl2-

Calculate how many milliliters of 0.025 N of chloride solution we need to add to 400 ml of the mercury solution to complex all mercury ions in this solution. *Assume that only the above reaction takes place in the solution.*

Molecular weights (g/mole): Hg = 200.6; Cl = 35.5