Laboratory Techniques
Agri 201

Formula Information Sheet

I. Percent, and ppm, ppb.
   a. These values are ratios that are unitless terms that must be changed to a unit value for many calculations. The top and bottom units must be the same type of unit e.g. g/100g or mls /100ml. Milliliters (mLs) of water can be changed to grams (g) of water because 1ml of water weighs 1 g. (1g of water = 1ml of water).
      i. 1 percent = 1 part per hundred parts or 1g /100g, 1ml /100ml or 1g/100ml water.
      ii. 1 part per million (ppm) = 1 part per million (10^6) parts. 1ppm = 1mg/Kg or 1mg/L or 1ug/g or 1ug/ml.
      iii. 1 part per billion (ppb) = 1 part per billion (10^9) parts. 1ppb = 1ug/Kg or 1ug/L or 1ng/g or 1ng/ml.

   b. Converting percent, ppm and ppb to other ratios
      i. ___% * 10,000 = ___ppm
      ii. ___ppm / 10,000 = ___%, ___ppm * 1000 =___ ppb
      iii. ____ppb / 1000 = ____ppm

   c. Converting ppm to Molarity (steps)
      i. Convert ppm to unit value e.g.222 ppm $CaCl_2$ = 222mg $CaCl_2$ / L
      ii. Determine molecular wt of compound e.g. M.W. Ca = 40 mg/mMole, Cl = 35.5 mg / mMole. M.W. $CaCl_2$ = 40mg + (2* 35.5mg) = 111mg $CaCl_2$ /mMole of $CaCl_2$
      iii. Divide wt. of compound by the molecular weight of the compound e.g. 222 mg CaCl2 / (111mg $CaCl_2$ / mmole) = 2 mM $CaCl_2$.
   d. Converting ppm to normality (steps)
      i. Convert ppm to unit value e.g.222 ppm $CaCl_2$ = 222mg $CaCl_2$ / L
      ii. Determine milli-equivalent meq weight of compound by dividing molecular weight by the charge of the compound when dissolved in water. e.g. $CaCl_2$ --- Ca+2 and 2 Cl- so the charge is 2. $CaCl_2$ would have a milli-equivalent wt of 111/2 or 55.5mg/ meq.
      iii. Divide wt. of compound by the milli-equivalent weight of the compound. (222mg $CaCl_2$ /L) / (55.5 mg of $CaCl_2$/ meq $CaCl_2$)= 4 meq $CaCl_2$.
      iv. Shortcut – If you know the molarity then multiply the molarity by the charge to obtain the normality e.g. 2mM $CaCl_2$ /L * 2 meq $CaCl_2$ / mmole $CaCl_2$ = 4 meq $CaCl_2$ /L
   e. Sample problems
      i. What is the molarity of a 98 ppm H_2SO_4 solution.(1mM H_2SO_4)

ii. What is the normality of a 98 ppm H_2SO_4 solution.(2m$\underline{N}$ H_2SO_4)
iii. Convert 25,000 ppm NaCl to percent. (2.5% NaCl)
iv. Convert 5.2% NaCl to ppm NaCl. (52,000 ppm NaCl)

II. Acid / Base calculations
   a. pH = - Log $[H^+]$ or 10^{-pH}= moles H^+/L
      e.g. {pH of 5 = .00001 moles H^+/liter.} , { 0.0001M H+ = $10^{-4}H^+$ or Ph = 4}
   b. Acid / base titrations
      i. Acids are labeled by using moles of H+ /L, equivalents (eq) H+/L or normality. 1 mole H+/L = 1 eq / liter = 1 Normal or 1$\underline{N}$
      ii. Bases are labeled by moles of OH- / L , eq OH-/L, Normality or $\underline{N}$
      iii. 1 equivalent of base will neutralize one equivalent of acid.
      iv. Normality X volume = equivalents / liter 100 mls of a 1N HCl solution will have 0.1 equivalents of