Fundamentals of Analytical Chemistry

Chapter 4

Calculations Used in Analytical Chemistry

Homework

- Homework assignments will normally only include questions marked with an asterisk (*)
- In some cases only certain parts of a problem are so marked (i.e. #14)– in that case you are only responsible (for purposes of any quiz) for those parts that are marked.
- Questions 7-13 odd, 14, 15, 19-23 odd, 29-37 odd

SI units

Quantity	Unit	Abbr.
Mass	kilogram	kg
Length	meter	m
Time	second	s
Temperature	kelvin	K
Amount of Substance	mole	mol
Electric current	ampere	A
Luminous intensity	candela	cd

Other common units

- Liter (L)
  - 10^{-3} m^3
- Weight
  - Mass * gravity
- Molarity (M)
  - Moles of solute per L of solution
  - mol/L

Question

A scientist prepares a solution by dissolving exactly 0.1 mol of $HCl_{(g)}$ in water, and diluting the solution to exactly 1 L.

What is [HCl]?

Concentration

- Equilibrium concentration
  - Concentration of substance that is in a solution when it has reached equilibrium.
  - Units of molarity for this concentration are indicated by square brackets surrounding the name of the species (as in [HCl])
- Analytical concentration
  - Concentration of substance initially present (before equilibrium)
  - C_{HCl}

Question

A scientist prepares a solution by dissolving exactly 0.1 mol of $HCl_{(g)}$ in water, and diluting the solution to exactly 1 L.

What is [HCl]?

- [HCl] = ~0 M
- C_{HCl} = 0.1 M

Percent Concentration

- 3 possible types
  - Weight percent
    - (weight solute/weight solution) * 100%
  - Volume percent
    - (volume solute/volume solution) * 100%
  - Weight/volume percent
    - (weight solute,g/volume solution, mL) * 100%
- 'Default' assumption is wt/wt %

Other concentrations

- Parts per million (ppm)
  - Replace 100% with 1,000,000
  - For a dilute, aqueous solution we can assume that the concentration in ppm is equal to the concentration in mg/L
    - Assume the density of the solution is the same as the density for water
      - 1L = 1,000 mL = 1,000 g = 1,000,000 mg
      - (mass of solute / 10^6 mg solution) * 10^6 = ppm
- Parts per billion
  - Replace 100% with 1,000,000,000

Manipulations

- p-Functions
  - negative logarithm (base 10) of the value following the p
    - pH = -log $[H^+]$
    - pKa = -log Ka
- Density (d)
  - mass/vol (any units)
- Specific gravity
  - $d_{solution}$ / d_{water}
  - will approximately equal density in units of g/mL