



Republic of Iraq
Ministry of Higher Education & Scientific research
Al-Mustaqbal University
Science College
Medical physics Department

Analytical Chemistry

For

First Year Student

Lecture 3

By

Dr. Assel Amer Hadi

2025-2026

The relationship between molarity, normality and part per million

$$1- \text{ppm} = M \times M.\text{wt} \times 1000$$

$$2- \text{ppm} = N \times M.\text{wt} \times 1000$$

Example :(a) Calculate the molar conc. of 1.0 ppm solutions each of Li^+ and Pb^{+2} .(b) What weight of $\text{Pb}(\text{NO}_3)_2$ will have to be dissolved in 1 liter of water to prepare a 100 ppm Pb^{+2}

solution:

$$M = \frac{\text{ppm}}{m.\text{wt} \times 1000}$$

$$M_{\text{Li}^+} = \frac{1.0}{6.94 \times 1000} = 1.44 \times 10^{-4} \text{ mole/L}$$

$$M_{\text{pb}} = \frac{1.0}{207 \times 1000} = 4.83 \times 10^{-6} \text{ mole/L}$$

$$M_{+} = \frac{100}{207 \times 1000} = 4.83 \times 10^{-4} \text{ mole/L}$$

$$M = \frac{\text{wt}}{m.\text{wt}} \times \frac{1000}{V \text{ mL}}$$

$$4.83 \times 10^{-4} = \frac{\text{wt}}{283.2} \times \frac{1000}{1000}$$

$$\text{Wt} = 0.137 \text{g pb}(\text{NO}_3)_2$$

Example: The concentration of Zinc ion (Zn^{+2}) in blood serum is about (1ppm). Express this as meq/L.

Q1:- Calculate the molar concentration of 1 ppm solutions of each of the following?

a) AgNO₃ b) Al₂(SO₄)₃ c) CO₂ d) HClO₄

Q2: Calculate the ppm conc. Of 2.5×10^{-4} M solutions of each of the following ?

a) Ca⁺² b) CaCl₂ c) HNO₃ d) KCN

Molarity concentration for solution prepared from dissolved liquid solute in liquid solvent.

$$M = \frac{\% \times \text{density} \times 1000}{M.wt} = \frac{\% \times \text{sp.gr} \times 1000}{M.wt}$$

Notice -The Specific gravity (sp. gr.) its without unit.

Density: is the weight per unit volume at the specified temperature, usually (gm/mL) or (gm/cm³) or (gm.cm⁻³) in 20C (is the ratio of the mass in (gm) and volume (mL).

Example :Calculate the molarity of 28.0% NH₃, specific gravity 0.898.

Solution:

$$M.wt \text{ NH}_3 = 14 + (3 \times 1) = 17 \quad M = \frac{\% \times \text{density} \times 1000}{M.wt}$$

$$M = \frac{\frac{28}{100} \times 0.898 \times 1000}{17}$$

$$M = 16.470 \text{ mmol mL} = 16.470 \text{ M}$$

Diluting Solutions: We often must prepare dilute solutions from more concentrated stock solutions. For example ,we may prepare a dilute HCL solution from concentrated HCL to be used for titration .Or ,we may have a stock standard solution from which we wish to prepare a series of more dilute standards. The

millimoles of stock solution taken for dilution will be identical to the millimoles in the final diluted solution.

$$M_{\text{stock}} \times V_{\text{stock}} = M_{\text{diluted}} \times V_{\text{diluted}}$$

Example: What is the molarity and normality of a 13.0% solution of H_2SO_4 ? To what volume should 100 ml of acid be diluted in order to prepare a 1.50 N solution?

Solution: From specific gravity table in the appendix, the specific gravity of the acid is 1.090.

$$M = \frac{\% \times \text{sp. gr} \times 1000}{M. wt}$$

$$\frac{0.13 \times 1.09 \times 1000}{98}$$

$$M=1.45 \text{ M}$$

$$M_1 \times V_1 = M_2 \times$$

$$2.90 \times 100 = 1.50 \times V_2$$

$$V_2=193 \text{ mL}$$

p- Functions

Scientists frequently express the concentration of a species in terms of its p-function, or p-value. The p-value is the negative logarithm (to the base 10) of the molar concentration of that species. Thus, for the species X,

$$pX = -\log [X]$$

As shown by the following examples, p-values offer the advantage of allowing concentrations that vary over ten or more orders of magnitude to be expressed in terms of small positive numbers

Example : Calculate the p-value for each ion in a solution that is 2.00×10^{-3} M NaCl and 5.4×10^{-4} M in HCl.

Solution:



$$\text{pH} = -\log [\text{H}^+] = -\log (5.4 \times 10^{-4}) = 3.27$$

$$\text{pNa} = -\log (2.00 \times 10^{-3}) = -\log 2.00 \times 10^{-3} = 2.699$$

$$[\text{Cl}^-] = 2.00 \times 10^{-3} \text{ M} + 5.4 \times 10^{-4} \text{ M}$$

$$= 2.00 \times 10^{-3} \text{ M} + 0.54 \times 10^{-3} \text{ M} = 2.54 \times 10^{-3} \text{ M}$$

$$\text{pCl} = -\log 2.54 \times 10^{-3} \text{ M} = 2.595$$

Example : Calculate the molar concentration of Ag^+ in a solution that has a pAg of 6.372.

solution:

$$\text{pAg} = -\log [\text{Ag}^+] = 6.372, \log [\text{Ag}^+] = -6.372$$

$$[\text{Ag}^+] = \frac{-6.372}{\log} = \text{Log}^{-1} (-6.372) = 4.246 \times 10^{-7} = 4.25 \times 10^{-7} \text{ M}$$