Ministry of higher education and scientific research
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Department of medical physics

Stage one

General chemistry (practical)

Lecture 2

Methods of Expressing Concentration of Solutions

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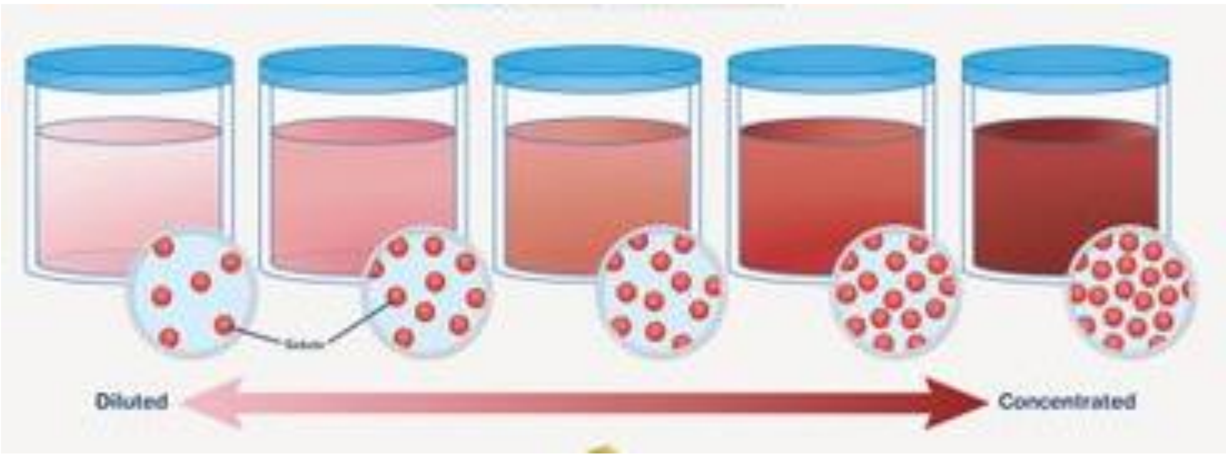
CONCENTRATION

The amount of solute present in the given quantity of solvent or solution.



METHODS TO EXPRESS CONCENTRATION:

i. **Mass percentage:** Mass of solute per100g of solution.

Mass % = (mass of solute / total mass of solution) X 100

ii. **Volume percentage:** volume of solute per100ml of solution.

Volume % = (volume of solute/ total volume of solution) X 100

iii. **Mass by volume percentage (w/V):** Another unit which is commonly used in medicine and pharmacy is mass by volume percentage. It is the mass of solute dissolved in 100 mL of the solution.

Mass by Volume % = (mass of solute/ total volume of solution) X 100

iv. **Parts per million:** parts of a component per million parts of the solution.

Parts per million =(Number of parts of the component /Total number of parts of all components of the solution) ×106

v. **Mole fraction(x):** The mole fraction, χ, of a component in a solution is the ratio of the number of moles of that component to the total number of moles of all components in the solution.

To calculate mole fraction, we need to know: The number of moles of each component present in the solution.

The mole fraction of A, χA, in a solution consisting of A, B, C, ... is calculated using the equation:

$$X_A = \frac{\text{moles of A}}{\text{moles of A + moles of B + moles of C + ····}}$$

To calculate the mole fraction of B, X_B, use:

$$X_B = \frac{\text{moles of B}}{\text{moles of A + moles of B + moles of C + ····}}$$

vi. **Molarity(M):** No. of moles of solute dissolved in one litre of solution.

Molarity(M) = moles of solute/ vol. of solution in litre

SHORT FORM: MOLAR

vii. **molality(m):** No. of moles of solute per kg of the solvent. molality(m) = moles of solute/mass of solvent in kg

SHORT FORM: MOLAL

Molality is independent of temp. whereas molarity is a function of temp. because vol. depends on temp. and mass does not

HOW TO PREPARE SOLUTIONS IN LABORATORY

What is standard solution?

(A solution whose concentration is known)

For example to prepare 1M Na OH solution.,.,,

- First we have to calculate the amount of solute required to prepare 1M NaOH standard solution
  M=n/V(in L)
  n=MxV
  =1x1(M=1, V=1L)
  n=1
  Mass of NaOH /Molar mass of NaOH =1
  Mass of NaOH=1 X Molar mass of NaOH
  =1x40(molar mass of NaoH = 40 g/mol)
  =40g
- Hence we need 40g NaOH to prepare !M standard solution

Dilutions

Whenever you need to go from a more concentrated solution **[“stock”]** to a less concentrated one, you add solvent [usually water] to “dilute” the solution.

No matter what the units of concentration are, you can always use this one formula.

$$\text{n. of moles}_1 = \text{n. of moles}_2$$

$$n1 = n2$$

$$\mathbf{C1\ V1 = C2\ V2}$$

[Concentration of the stock] x [Volume of the stock] = [Concentration of the final solution] x Volume of the final solution]

$$N_1 V_1 = N_2 V_2$$

$$M_1 V_1 = M_2 V_2$$

$$ppm_1 V_1 = ppm_2 V_2$$

Q1 / What is the volume of 0.2 mol / L of NaOH that it required to dilute it to 0.05 mol /L in 100 ml ?

N1 V1 = N2 V2

0.2 x V1 = 0.05 x 100   V1= 25 ml complete to 100 ml

Q2/ A 40.0 mL volume of 1.80 M Fe(NO3)3 is mixed with 21.5 mL of 0.808M Fe(NO3)3 solution Calculate the molar concentration of the final solution.

Sol/

n. Of moles = M * V(L) = 1.8 * 0.04 = 0.072 moles (for solution 1)
n.of moles = M * V(L) = 0.808 * 0.0215 = 0.0173 moles (for solution 2) n. of moles for final solution = n1 + n2 = 0.072 + 0.0173 = 0.0893 moles M = n / V(L)
M = 0.0893 / 0.0615 = 1.45 mol/L
Other solution /
M1V1 + M2V2 = M3V3 (1.80) (40.0) + (0.808) (21.5) = (M3) (40.0 + 21.5
1.45 M

Then are you ready to answer these questions ?

1. A 1.88 M solution of NaCl has an initial volume of 34.5 mL. What is the final concentration of the solution if it is diluted to 134 mL?
2. A 0.664 M solution of NaCl has an initial volume of 2.55 L. What is the final concentration of the solution if it is diluted to 3.88 L?
3. How much water must be added to 1.55 L of 1.65 M Sc(NO3)3(aq) to reduce its concentration to 1.00 M?

Reagents Concentration Calculation

Normality and Molarity:

$$\text{Normality} = \frac{\text{Specific Gravity (g/l)} \times \text{Percentage (\%)} \times 1000}{\text{Equivalent Weight (g/ eq)}}$$

$$\text{Molarity} = \frac{\text{Specific Gravity (g/l)} \times \text{Percentage (\%)} \times 1000}{\text{Molecular Weight (g/ mol)}}$$