Preparation of solutions

College of Science

Department of Forensic Evidence Science

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Lecture. 2

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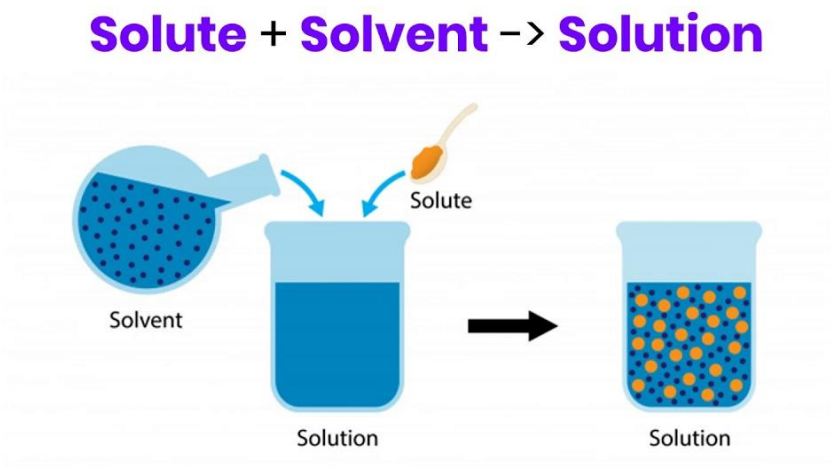
Solution: Is a special type of homogeneous mixture composed of two or more substances, one of them called solute and the other one is the solvent.



* A solution is created by dissolving one or more solutes in a solvent.

Concentration: Is a general term that expresses the quantity of solute contained in a given amount of solution

1- Concentration Percentage: There are three different ways of representing percent concentration:

a) Weight percent (wt/wt): It is the number of grams of solute per 100g of solvent or solution (wt/wt)

weight percent (wt/wt) = $\frac{wt.\ of\ solute}{wt.\ of\ solution}$ **x 100**

b) Volume percent (v/v): It is the number of milliliters of solute per 100ml of solvent or solution (v/v)

Volume percent (v/v) = $\frac{volume\ of\ solute}{volume\ of\ solution}$ **x 100**

c) Weight -Volume percent (wt/v): It is the number of grams of solute per 100ml of solvent or solution (wt/v)

Weight-volume percent (wt/v) = $\frac{wt.\ of\ solute}{volume\ of\ solution}$ **x 100**

2- Molarity (mole /volume)

- Is the number of moles of solute per liter of solution.

- Molarity is expressed in mol L^{-1}

$$M = \frac{wt.}{m.wt.} * \frac{1000}{v(ml)}$$

wt. + m.wt. ➔ solute

volume ➔ solution

3- Normality (N)

- Is the number of equivalents weight per liter of solution.

$$N = \frac{wt.}{eq.wt.} * \frac{1000}{v(ml)}$$

wt. + eq.wt. ➔ solute

volume ➔ solution

Equivalent mass of acids

$Eq = \frac{M.wt.}{number\ of\ H}$ ⟹ $Eq = \frac{Mwt}{2} = \frac{98}{2} = 49$ for H_2SO_4

Equivalent mass of Bases

$Eq = \frac{M.wt.}{number\ of\ OH}$ ⟹ $\mathbf{Eq.} = \frac{Mwt}{1} = \frac{56}{1} = 56$ for KOH

Equivalent mass in (oxidation – reduction) reaction (Redox)

$\mathbf{Eq} = \frac{Mwt}{\eta}$ **η= change in oxidation state number**

η= numbers of electrons participate in oxidation - reduction processes (Redox)

Example :

$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \rightarrow 5Fe_2(SO_4)_3 + 2MnSO_4 + K_2SO_4 + 8H_2O$

$2MnO_4^- + 10Fe^{2+} + 8H^+ \rightleftharpoons 10Fe^{3+} + 2MnSO_4$ (acidic medium)

$Mn^{7+} \rightarrow Mn^{2+}$ (5 e gain – reduction)

$Fe^{2+} \rightarrow Fe^{3+}$ (1 e loss – oxidation)

Eq. of $KMnO_4 = \frac{Mwt}{5} = \frac{157.9}{5} = 31.6$

Equivalent mass for salts

$$Eq = \frac{Mwt}{\eta}$$

(η) = Σ [no. of cations x its valency (cation charge)]

e.g: **$BaSO_4$** **($Ba^{2+} + SO_4^{2-} \leftrightarrow BaSO_4$)**

η = Ba^{2+} (1) x (2+) =2

4- part per million (ppm)

$$\boldsymbol{ppm = \frac{wt.(mg)}{v(l)}}$$

This equation is used when the substance has unknown molecular weight

$$\boldsymbol{conc.(M)\ \frac{conc.(ppm)}{m.wt.*1000}}$$ ⟹ **ppm= M*m.wt.*1000**

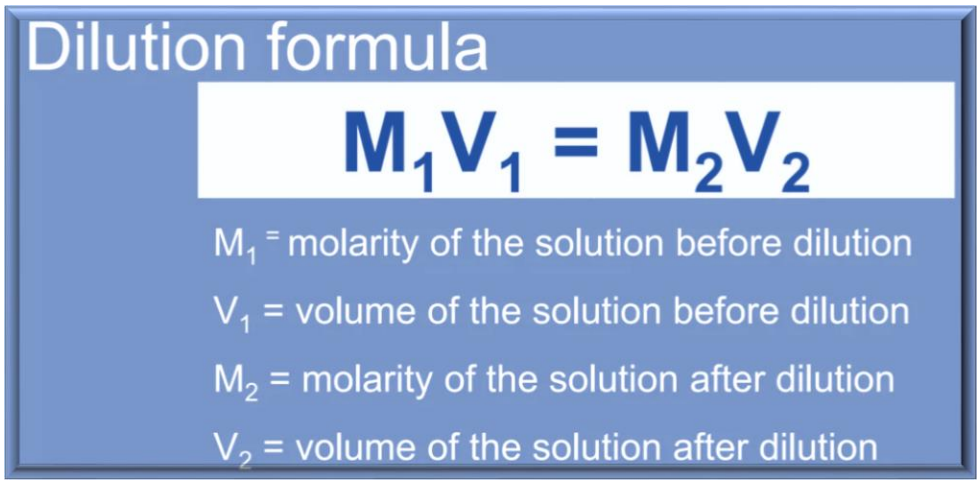
Standard Solution is a solution whose concentration is known accurately. Its concentration is usually given in Mol/L.

Preparing Stock Solutions

A stock solution is prepared by weighing out an appropriate portion of a pure solid or by measuring out an appropriate volume of a pure liquid and diluting to a known volume.

Preparing Solutions by Dilution

Solutions with small concentrations are often prepared by diluting a more concentrated stock solution. A known volume of the stock solution is transferred to a new container and brought to a new volume.



Common Prefixes used with SI Units			
Prefix	Symbol	Meaning	Order of Magnitude
giga-	G	1 000 000 000	10^9
mega-	M	1 000 000	10^6
kilo-	k	1 000	10^3
hecto-	h	100	10^2
deka-	da	10	10^1
	base unit	1	10^0
deci-	d	0.1	10^{-1}
centi-	c	0.01	10^{-2}
milli-	m	0.001	10^{-3}
micro-	μ	0.000 001	10^{-6}
nano-	n	0.000 000 001	10^{-9}

Quantity	Unit	Symbol
Volume	Litre	ℓ
Length	Meter	m
Mass	gram	g

Example/ prepare a solution of potassium permanganate at a concentration of 0.0002 M in 100 ml of distilled water. (M.Wt. of $KMNO_4$=158 g/mol)

Example/ from a 0.5 M of potassium permanganate solution, prepare a solution of 0.02 M in 100 ml. (The solvent used is distilled water)