EQUATIONS LECTURE 1

- **MOLE** (measure of the amount of substance)

$$\boxed{n = \frac{W}{m.m.}}$$

$\begin{cases} n = n° \text{ of moles } [mol] \\ W = \text{weight } [g] \\ m.m. = \text{molar mass } \left[\frac{g}{mol}\right] \end{cases}$

- **MOLARITY** (measure of the concentration of the solution)

$$\boxed{M = \frac{n}{V}}$$

$\begin{cases} M = \text{molarity } [M] \\ n = n° \text{ of moles } [mol] \\ V = \text{volume } [l] \end{cases}$

> **N.B.** Other less used ways to express the concentrations of solutions are:
>
> $\frac{\text{weight}}{\text{volume}}$ % $\quad \boxed{\frac{W}{V}\% = \frac{W_{solute}}{V_{solution}}}$
>
> $\frac{\text{weight}}{\text{weight}}$ % $\quad \boxed{\frac{W}{W}\% = \frac{W_{solute}}{W_{solution}}}$
>
> $\frac{\text{volume}}{\text{volume}}$ % $\quad \boxed{\frac{V}{V}\% = \frac{V_{solute}}{V_{solution}}}$
>
> $\begin{cases} W = \text{weight } [g] \\ V = \text{volume } [l] \end{cases}$

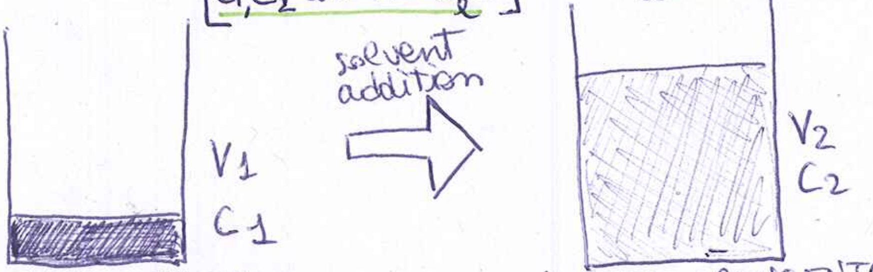
- **DILUTION OF SOLUTIONS:** you add solvent to a stock solution of concentration C_1 to prepare a new solution of concentration C_2 (more diluted than the first one).

$\boxed{n_1 = n_2}$ or $\boxed{W_1 = W_2}$ (conservation of mass)

$\downarrow$

$\boxed{C_1V_1 = C_2V_2}$ $[C_1, C_2 \text{ in } M = \frac{mol}{l}]$

$\boxed{C_1V_1 = C_2V_2}$ $[C_1, C_2 \text{ in } \frac{W}{V}\%]$



CONCENTRATED STOCK SOLUTION

LOWER CONCENTRATED FINAL SOLUTION

pH of Acid/ Base

Strong Acid

Strong acids dissociate completely into ions in aqueous solution.

$\boxed{[H^+] = [HA]_0 = C_0}$

for $[HA]_0 > 10^{-6}$

Weak Acid

	$HA(aq)$	$\rightleftharpoons$	$H^+(aq)$	+	$A^-(aq)$
t=0	$[HA]_0$		0		0
modification	-x		+x		+x
$t=t_{eq}$	$[HA]_0 - x$		+x		+x

$$\boxed{K_a = \frac{[A^-][H^+]}{[HA]} = \frac{x^2}{[HA]_0 - x}}$$

where $\boxed{x = \alpha [HA]_0}$

since by definition $\boxed{\alpha = \frac{[A^-]}{[HA]_0}}$

Strong Base

Strong bases dissociate completely into ions in aqueous solution.

$\boxed{[OH^-] = [BOH]_0 = C_0}$

for $[BOH]_0 > 10^{-6}$

Weak Base

	BOH	$\rightleftharpoons$	B^+	+	OH^-
t=0	$[BOH]_0$	-	0		0
~~t>0~~	-x	-	+x		+x
$t=t_{eq}$	$[BOH]_0 - x$	-	x		x

$$\boxed{K_b = \frac{[B^+][OH^-]}{[BOH]} = \frac{x^2}{[BOH]_0 - x}}$$

$$\boxed{pH = -\log_{10}[H^+]}$$
$$\boxed{pOH = -\log_{10}[OH^-]}$$
$$\boxed{pKa = -\log_{10} Ka}$$

(when $[AH]=[A^-]$ i.e. the acid is half-dissociated $pH = pKa$)