

## Molarity

$$M = \frac{n_{\text{substance}}}{V_{\text{solution}}} \text{ or } M = \frac{m_{\text{substance}}}{m_{\text{Msubstance}} V_{\text{solution}}}$$

## Normality

$$N = Eq_{\text{substance}} / V_{\text{solution}}$$

## Molality

$$m = \frac{n_{\text{substance}}}{m_{\text{solvent}}} \text{ or } m = \frac{m_{\text{substance}}}{m_{\text{Msubstance}} m_{\text{solvent}}}$$

## % w/w

$$c_{\% \text{ w/w}} = \frac{m_{\text{substance}}}{m_{\text{solution}}} \cdot 100\% \text{ or}$$

$$c_{\% \text{ w/w}} = \frac{m_{\text{substance}}}{m_{\text{substance}} + m_{\text{solvent}}} \cdot 100\%$$

## ppm, ppb, ppt

$$ppm = \frac{m_{\text{substance}}}{m_{\text{solution}}} \cdot 10^6 \quad ppb = 10^9, \quad ppt = 10^3$$

## molar fraction

$$x = \frac{n_{\text{substance}}}{\sum n_i} \text{ sum all substances present}$$

## dilution and mixing

$$M_1 V_1 + M_2 V_2 + \dots = M_F V_F \quad F \text{ for final}$$

## other equations

$$n_{\text{substance}} = m_{\text{substance}} / m_{\text{Msubstance}}$$

$$m_{\text{solution}} = m_{\text{solvent}} + m_{\text{substance}}$$

$$d = m_{\text{solution}} / (1000 V) \quad V \text{ in L}$$

## symbols used:

M – molarity – mol/L

N – normality – Eq/L

m – molality – mol/kg

Eq – number of equivalents

n – number of moles

$m_M$  – molar mass – g

V – volume – L

m – mass g

d – density – g/mL

## Concentration and Solution Calculator

**CASC** – program for fast and easy concentration calculations and solution recipes preparation.

## Conversion – to molarity

% w/w to molarity

$$M = \frac{10 c_{\%w/w} d}{m_{M\text{substance}}}$$

molality to molarity

$$M = \frac{1000 m d}{1000 + m m_{M\text{substance}}}$$

molar fraction to molarity

$$M = \frac{1000 d}{m_{M\text{substance}} + \frac{(1-x)}{x} m_{M\text{solvent}}}$$

## Conversion – from molarity

molarity to % w/w

$$c_{\%w/w} = \frac{M m_{M\text{substance}}}{10 d}$$

molarity to molality

$$m = \frac{1000 M}{1000 d - M m_{M\text{substance}}}$$

molarity to molar fraction

$$x = \frac{M m_{M\text{solvent}}}{1000 d + M (m_{M\text{solvent}} - m_{M\text{substance}})}$$

## density tables g/mL

% w/w	NaOH	H <sub>2</sub> SO <sub>4</sub>	acetic	HCl	NH <sub>3</sub>
0.0	0.9991	0.9991	0.9982	0.9982	0.9991
1.0	1.0106	1.0054	0.9997	1.0032	0.9956
2.0	1.0219	1.0129	1.0012	1.0082	0.9913
3.0	1.0331	1.0198	1.0026	1.0132	0.9832
4.0	1.0443	1.0266	1.0041	1.0181	0.9792
5.0	1.0554	1.0334	1.0055	1.0230	0.9597
10.0	1.1111	1.0687	1.0126	1.0474	0.9421
15.0	1.1655	1.1048	1.0195	1.0725	0.9256
20.0	1.2219	1.1430	1.0261	1.0980	0.8951
30.0	1.3311	1.2212	1.0383	1.1493	
40.0	1.4339	1.3070	1.0488	1.1980	
50.0	1.5290	1.3989	1.0575		
60.0		1.5031	1.0642		
70.0		1.6150	1.0686		
80.0		1.7323	1.0699		
90.0		1.8197	1.0660		
100.0		1.8305	1.0497		