Concentration by percent

weight/ weight	$\left(\frac{\text{wt}}{\text{wt}}\%\right) = \frac{\text{wt solute (g)}}{\text{wt solution or sample (g)}} \times 100 = \frac{\text{wt solute (mg)}}{\text{wt solution or sample (mg)}} \times 100$
Weight/volume	$\left(\frac{\text{wt}}{\text{V}}\%\right) = \frac{\text{wt solute (g)}}{\text{V solution or sample (mL)}} \times 100 = \frac{\text{wt solute (mg)}}{\text{V solution or sample (µL)}} \times 100$
Volume/volume	$\left(\frac{\text{V}}{\text{V}}\%\right) = \frac{\text{V solute (mL)}}{\text{V solution or sample (mL)}} \times 100 = \frac{\text{V solute (µL)}}{\text{V solution or sample (µL)}} \times 100$

ملاحظة للحل : وزن او حجم المحلول او النموذج (المقام) يعني المذاب+ المذيب **Solution=solute+solvent**
يتكون المقام من Solution يعني (solute+solvent)
يتكون البسط فقط مذاب solute
اذا ذكر بالسؤال كلمة *soil , sample, water* تعني النموذج يجب ان يكون في المقام

***Example*(1):**-Calculate the weight percentage of solution prepare by mixing 5.0g $AgNO_3$ with 100mL water (density 1g/cm^3).

Solution:

ml= cm3

Density = $\frac{wt.}{volume}$

Density =1g/cm^3= 1 g/ml

يجب الحصول على وزن الماء(المذيب) كالتالي

Density = $\frac{wt.}{volume} \rightarrow \frac{1\ g}{ml} = \frac{wt.}{100\ ml} \rightarrow wt = 100g$

وزن المحلول =وزن المذاب+ وزن المذيب

وزن المحلول = وزن الماء + وزن $\mathbf{AgNO_3}$

وزن المحلول = 100 +5 =105 g

$$\left(\frac{wt}{wt}\%\right) = \frac{\text{wt solute (g)}}{\text{wt solution (g)}} \times 100, \rightarrow \left(\frac{wt}{wt}\%\right) = \frac{\text{wt solute } (AgNO_3)(g)}{\text{wt solute+wt solvent } (H_2O)\ (g)} \times 100$$

$$\left(\frac{wt}{wt}\%\right) = = \frac{5\ g}{105\ g} \times 100 = 4.76\%$$

***Example* (2):**-Calculate number of grams in 500 mL silane solution (wt/v % = 0.859%).

Solution:

وزن=number of grams

$$\left(\frac{\mathbf{wt}}{\mathbf{V}}\%\right) = \frac{\mathbf{wt\ solute\ (g)}}{\mathbf{V\ solution\ (mL)}} \times \mathbf{100}$$

$$\mathbf{0.859} = \frac{\mathbf{wt\ NaCl\ (g)}}{\mathbf{500}} \times \mathbf{100}$$

$$\mathbf{wt\ NaCl} = \frac{\mathbf{0.859} \times \mathbf{500}}{\mathbf{100}} = \mathbf{4.25\ g\ NaCl}$$

***Example*(3):**-Calculate the weight of glucose in litter solution(wt/v % = 5 %).

***Solution*:**

L=1000ml

$$\left(\frac{\mathbf{wt}}{\mathbf{V}}\%\right) = \frac{\mathbf{wt\ solute\ (g)}}{\mathbf{V\ solution\ (mL)}} \times \mathbf{100} = \frac{\mathbf{wt\ glucose\ (g)}}{\mathbf{V\ solution\ (mL)}} \times \mathbf{100}$$

$$\mathbf{5\%} = \frac{\mathbf{wt\ glucose\ (g)}}{\mathbf{1000\ (mL)}} \times \mathbf{100}$$

$$\mathbf{wt\ glucose} = \frac{\mathbf{5} \times \mathbf{1000}}{\mathbf{100}} = \mathbf{50\ g}$$

***Example*(4):**-Calculate the volume percentage of solution preparing by mixing 50mL methyl alcohol with 200mL water.

***Solution*:**

هنا المذيب يتكون من مزيج ماء وكحول
حجم كلي للمذيب (المقام)= ماء+كحول
حجم كلي للمذيب= 50 +200= 250 مل

$$\left(\frac{\mathbf{V}}{\mathbf{V}}\%\right) = \frac{\mathbf{V\ solute\ (mL)}}{\mathbf{V\ solution\ or\ sample\ (mL)}} \times \mathbf{100}$$

$$= \frac{\mathbf{V\ methyl\ alcohol\ (mL)}}{\mathbf{V\ methyl\ alcohol + V\ water\ (mL)}} \times \mathbf{100} = \frac{\mathbf{50\ mL}}{\mathbf{(50 + 200)mL}} \times \mathbf{100} = \mathbf{20\%}$$

***Example*(5):**-calculate the volume of ethanol in litter solution consists of ethanol and water 0.9%(v/v%)?

***Solution*:**

L=1000ml

$$\left(\frac{\mathbf{V}}{\mathbf{V}}\%\right) = \frac{\mathbf{V\ ethanol\ (mL)}}{\mathbf{V\ solution}} \times \mathbf{100}$$

$$\mathbf{0.9} = \frac{\mathbf{V\ ethanol}}{\mathbf{1000mL}} \times \mathbf{100}$$

$$\mathbf{V\ ethanol} = \frac{\mathbf{0.9 * 1000}}{\mathbf{100}} = \mathbf{9\ ml}$$

Concentration in parts per thousand or million or billion

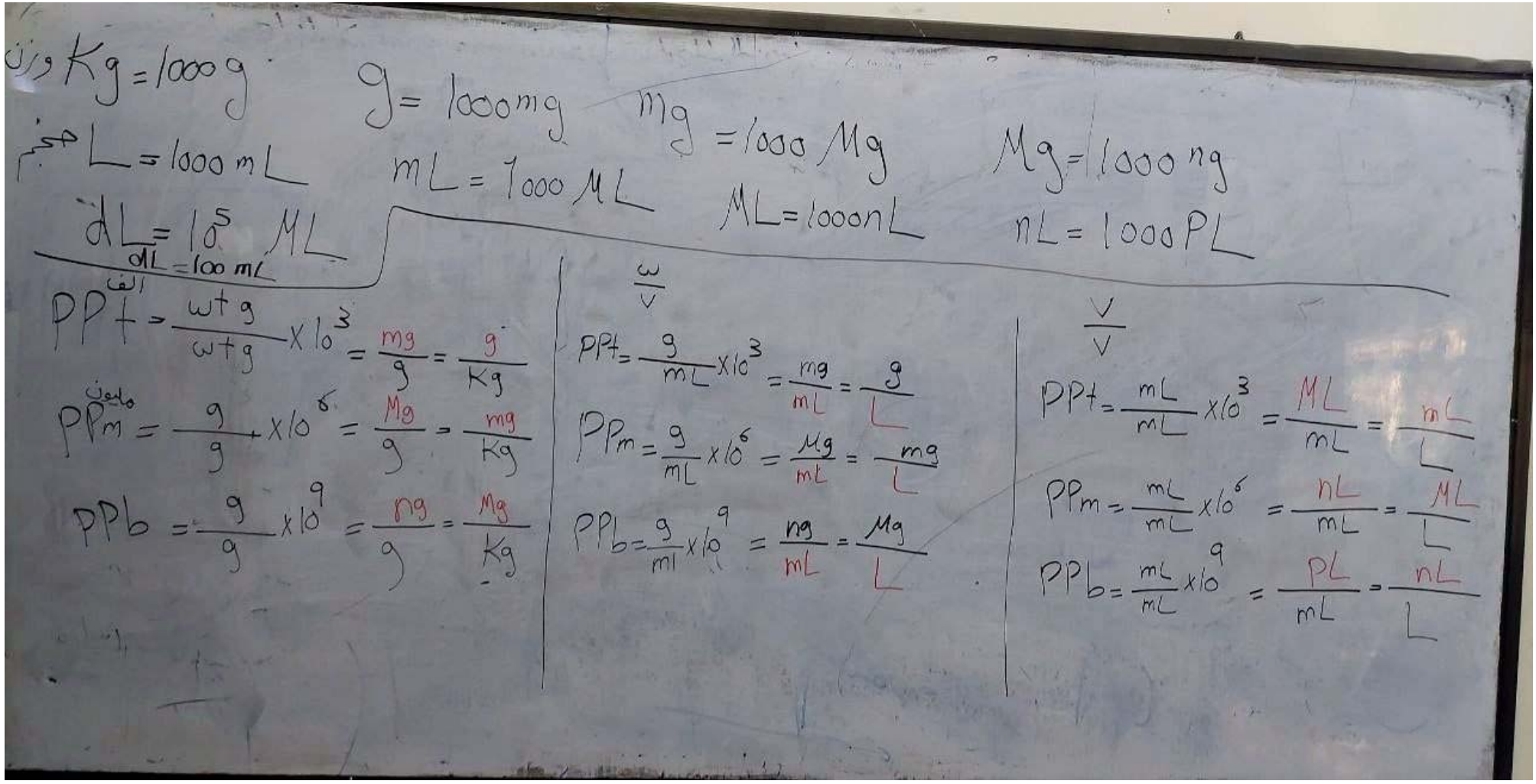
وزن / وزن
$\textbf{part per thousand (ppt)}\left(\frac{\text{wt}}{\text{wt}}\right) = \frac{\textbf{wt solute (g)}}{\textbf{wt solution (sample)(g)}} \times 10^3 = \frac{\textbf{wt (mg)}}{\textbf{wt (g)}} = \frac{\textbf{wt (g)}}{\textbf{wt (kg)}}$
$\textbf{part per million (ppm)}\left(\frac{\text{wt}}{\text{wt}}\right) = \frac{\textbf{wt solute (g)}}{\textbf{wt solution (sample)(g)}} \times 10^6 = \frac{\textbf{wt (µg)}}{\textbf{wt (g)}} = \frac{\textbf{wt (mg)}}{\textbf{wt (kg)}}$
$\textbf{part per billion (ppb)}\left(\frac{\text{wt}}{\text{wt}}\right) = \frac{\textbf{wt solute (g)}}{\textbf{wt solution (sample)(g)}} \times 10^9 = \frac{\textbf{wt (ng)}}{\textbf{wt (g)}} = \frac{\textbf{wt (µg)}}{\textbf{wt (kg)}}$
وزن/ حجم
$\textbf{part per thousand (ppt)}\left(\frac{\text{wt}}{\text{V}}\right) = \frac{\textbf{wt solute (g)}}{\textbf{V solution (sample)(mL)}} \times 10^3 = \frac{\textbf{wt (mg)}}{\textbf{V (mL)}} = \frac{\textbf{wt (g)}}{\textbf{V (L)}}$
$\textbf{part per million (ppm)}\left(\frac{\text{wt}}{\text{V}}\right) = \frac{\textbf{wt solute (g)}}{\textbf{V solution (sample)(mL)}} \times 10^6 = \frac{\textbf{wt (µg)}}{\textbf{V (mL)}} = \frac{\textbf{wt (mg)}}{\textbf{V (L)}}$
$\textbf{part per billion (ppb)}\left(\frac{\text{wt}}{\text{V}}\right) = \frac{\textbf{wt solute (g)}}{\textbf{V solution (sample)(mL)}} \times 10^9 = \frac{\textbf{wt (ng)}}{\textbf{V (mL)}} = \frac{\textbf{wt (µg)}}{\textbf{V (L)}}$

حجم / حجم
part per thousand (ppt) $\left(\frac{V}{V}\right) = \frac{\text{wt solute (mL)}}{\text{V solution (sample)(mL)}} \times 10^3 = \frac{\text{V (µL)}}{\text{V (mL)}} = \frac{\text{V (mL)}}{\text{V (L)}}$
part per million (ppm) $\left(\frac{V}{V}\right) = \frac{\text{wt solute (mL)}}{\text{V solution (sample)(mL)}} \times 10^6 = \frac{\text{V (nL)}}{\text{V (mL)}} = \frac{\text{V (µL)}}{\text{V (L)}}$
part per billion (ppb) $\left(\frac{V}{V}\right) = \frac{\text{wt solute (mL)}}{\text{V solution (sample)(mL)}} \times 10^9 = \frac{\text{V (pL)}}{\text{V (mL)}} = \frac{\text{V (nL)}}{\text{V (L)}}$

الوزن	**Kg=1000g**	**g=1000 mg**	**mg=1000 µg**	**µg=1000 ng**
	g=10^6 µg	**g=10^9 ng**		
الحجم	**L=1000ml**	**ml=1000 µL**	**µL=1000 nL**	**nL =1000 pL**
	L=10^6 µL	**1dL=100 mL**	**1dL=10^5 µL**	
	dL=deciliter	**pL =Picoliter**	**nL =Nanoliter**	

الوزن	Kg=1000g	g=1000 mg	mg=1000 µg	µg=1000 ng
الحجم	L=1000ml	ml=1000 µL	µL=1000 nL	nL =1000 pL

وزن / وزن	وزن/ حجم	حجم / حجم
$\text{ppt} = \frac{\text{g}}{\text{g}} \times 10^3 = \frac{\text{mg}}{\text{g}} = \frac{\text{g}}{\text{kg}}$	$\text{ppt} = \frac{\text{g}}{\text{ml}} \times 10^3 = \frac{\text{mg}}{\text{mL}} = \frac{\text{g}}{\text{L}}$	$\text{ppt} = \frac{\text{ml}}{\text{ml}} \times 10^3 = \frac{\text{µL}}{\text{mL}} = \frac{\text{mL}}{\text{L}}$
$\text{ppm} = \frac{\text{g}}{\text{g}} \times 10^6 = \frac{\text{µg}}{\text{g}} = \frac{\text{mg}}{\text{kg}}$	$\text{ppm} = \frac{\text{g}}{\text{ml}} \times 10^6 = \frac{\text{µg}}{\text{mL}} = \frac{\text{mg}}{\text{L}}$	$\text{ppm} = \frac{\text{ml}}{\text{ml}} \times 10^6 = \frac{\text{nL}}{\text{mL}} = \frac{\text{µL}}{\text{L}}$
$\text{ppb} = \frac{\text{g}}{\text{g}} \times 10^9 = \frac{\text{ng}}{\text{g}} = \frac{\text{µg}}{\text{kg}}$	$\text{ppb} = \frac{\text{g}}{\text{ml}} \times 10^9 = \frac{\text{ng}}{\text{mL}} = \frac{\text{µg}}{\text{L}}$	$\text{ppb} = \frac{\text{ml}}{\text{ml}} \times 10^9 = \frac{\text{pL}}{\text{mL}} = \frac{\text{nL}}{\text{L}}$


وزن
Kg = 1000 g
g = 1000 mg
mg = 1000 Mg
Mg = 1000 ng
حجم
L = 1000 mL
mL = 1000 ML
ML = 1000 nL
nL = 1000 PL
dL = 10^5 ML
dL = 100 mL
الف
PPt = wt g / wt g x 10^3 = mg / g = g / Kg
PPm = g / g x 10^6 = Mg / g = mg / Kg
PPb = g / g x 10^9 = ng / g = Mg / Kg
w / v
PPt = g / mL x 10^3 = mg / mL = g / L
PPm = g / mL x 10^6 = Mg / mL = mg / L
PPb = g / mL x 10^9 = ng / mL = Mg / L
v / v
PPt = mL / mL x 10^3 = ML / mL = mL / L
PPm = mL / mL x 10^6 = nL / mL = ML / L
PPb = mL / mL x 10^9 = pL / mL = nL / L

Common Units for Expressing Trace Concentrations

Unit	Abbreviation	wt/wt	wt/vol	vol/vol
Parts per million	ppm	mg/kg	mg/L	μL/L
(1 ppm = 10^{-4}%)		μg/g	μg/mL	nL/mL
Parts per billion	ppb	μg/kg	μg/L	nL/L
(1 ppb = 10^{-7}% = 10^{-3} ppm)		ng/g	ng/mL	pL/mL[a]
Milligram percent	mg%	mg/100 g	mg/100 mL	

[a] pL = picoliter = 10^{-12} L.

***Example* (6):**-A 2.6 g sample of plant tissue was analyzed and found to contain 3.6 µg zinc, what is the concentration of zinc in the plant in ppm? In ppb? In ppt?

***Solution*:-**

$$\textbf{ppm} = \frac{\textbf{wt (µg)}}{\textbf{wt (g)}} = \frac{\textbf{3.6 µg}}{\textbf{2.6 g}} = \textbf{1.4}\frac{\textbf{µg}}{\textbf{g}} = \textbf{1.4 ppm}$$

$$\textbf{ppb} = \frac{\textbf{wt (ng)}}{\textbf{wt (g)}} = \frac{\textbf{3.6} \times \textbf{10}^{\textbf{3}}\textbf{ng}}{\textbf{2.6 g}} = \textbf{1.4} \times \textbf{10}^{\textbf{3}}\frac{\textbf{ng}}{\textbf{g}} = \textbf{1400 ppb}$$

الافضل الحل بالطريقة التالية

$g=10^6$ µg
wt of solute $=3.6\times10^{-6}$ g

$(\text{ppt})\left(\frac{\text{wt}}{\text{wt}}\right)=\frac{\text{wt solute (g)}}{\text{wt solution (sample)(g)}}\times 10^3$	$(\text{ppm})\left(\frac{\text{wt}}{\text{wt}}\right)=\frac{\text{wt solute (g)}}{\text{wt solution (sample)(g)}}\times 10^6$	$(\text{ppb})\left(\frac{\text{wt}}{\text{wt}}\right)=\frac{\text{wt solute (g)}}{\text{wt solution (sample)(g)}}\times 10^9$
$(\text{ppt})\left(\frac{\text{wt}}{\text{wt}}\right)=\frac{3.6\times10^{-6}\ \text{g}}{2.6\ \text{g}}\times 10^3$	$(\text{ppm})\left(\frac{\text{wt}}{\text{wt}}\right)=\frac{3.6\times10^{-6}\ \text{g}}{2.6\ \text{g}}\times 10^6$	$(\text{ppb})\left(\frac{\text{wt}}{\text{wt}}\right)=\frac{3.6\times10^{-6}\ \text{g}}{2.6\ \text{g}}\times 10^9$
$=0.00138\approx 0.0014$ ppt	**$=1.38\approx 1.4$ ppm**	**$=1384.6\approx 1400$ ppb**

***Example* (7):-**A 25.0 µL serum sample was analyzed for glucose content and found to contain 26.7 µg. Calculate the concentration of glucose in ppm? In ppb? In ppt? and in mg/dL.

Solution:

ml=1000 µL $\Longrightarrow = \frac{25.0\ (\mu\text{L})}{1000\ (\frac{\mu\text{L}}{\text{mL}})} = 0.025\ (\text{mL})$

$$\mathbf{ppm} = \frac{\mathbf{wt\ (\mu g)}}{\mathbf{V\ (mL)}} = \frac{\mathbf{26.7\ (\mu g)}}{\mathbf{0.025\ (mL)}}$$

$$= \mathbf{1.07 \times 10^3}\ (\frac{\mathbf{\mu g}}{\mathbf{mL}}) = \mathbf{1.07 \times 10^3\ ppm}$$

الحل بالطريقة التالية(ppm, ppb, ppt)

g=10^6 µg **wt of solute =26.7×10^{-6} g**	**mL=1000 µL** **volume of sample= 25×10^{-3} mL**	
$(\mathbf{ppt})\left(\frac{\mathbf{wt}}{\mathbf{V}}\right) = \frac{\mathbf{26.7 \times 10^{-6} 10\ g}}{\mathbf{25 \times 10^{-3} mL}} \times \mathbf{10^3}$ **=1.068 ≈ 1.07 ppt**	$(\mathbf{ppm})\left(\frac{\mathbf{wt}}{\mathbf{V}}\right) = \frac{\mathbf{26.7 \times 10^{-6} 10\ g}}{\mathbf{25 \times 10^{-3} mL}} \times \mathbf{10^6}$ **=1068 ≈ 1070 ppm**	$(\mathbf{ppb})\left(\frac{\mathbf{wt}}{\mathbf{V}}\right) = \frac{\mathbf{26.7 \times 10^{-6} 10\ g}}{\mathbf{25 \times 10^{-3} mL}} \times \mathbf{10^9}$ **=1068000≈ 1070000 ppb**

المطلب الثاني بوحدات mg/dL :

mg=1000 µg $= \frac{26.7\ (\mu g)}{1000\ (\frac{mg}{\mu g})} = 0.0267(mg)$

$1dL=10^5\ \mu L$ $= \frac{25\ (mL)}{100000\ (\frac{dL}{mL})} = 0.00025(dL)$

$$\frac{wt\ (mg)}{V\ (dL)} = \frac{0.0267\ mg}{0.00025\ dL} = 106.8\ mg/dL$$

Homework: **What weight of Na_2SO_4 in 9 L of a solution that is 60 ppm?**

Solution:

$$ppm = \frac{Wt.\ g}{V\ ml} \times 10^6 = \frac{\mu g}{mL} = \frac{mg}{L}$$

$$60\ (\frac{mg}{\cancel{L}}) = \frac{Wt}{9\ \cancel{L}}$$

Wt= 540 mg

Homework: A 3 mL sample of wastewater was analyzed and found to contain 2.5 µL of Cd^{+2}, what is the concentration of Cd^{+2} in the wastewater in ppm? In ppb?

Solution:

$$\textbf{ppm} = \frac{\text{V ml}}{\text{V ml}} \times 10^6 = \frac{\text{nL}}{\text{mL}} = \frac{\mu\text{L}}{\text{L}}$$

µL=1000 nL

2.5*1000= 2500 nL

$$\textbf{ppm} = \frac{\text{V (nL)}}{\text{V (mL)}} = \frac{2500\ \text{nL}}{3\ \text{mL}} = 833.3\ \frac{\text{nL}}{\text{mL}} = 833.3\ \text{ppm}$$

$$\textbf{ppb} = \frac{\text{V ml}}{\text{Vml}} \times 10^9 = \frac{\text{pL}}{\text{mL}} = \frac{\text{nL}}{\text{L}}$$

ml=1000 µL

$$\frac{2.5}{1000} = 0.0025\ mL$$

$$\textbf{ppb} = \frac{\text{V ml}}{\text{Vml}} \times 10^9 = \frac{0.0025}{3} \times 10^9 = 0.000833 \times 10^9\ \text{ppb}$$

الافضل الحل بالطريقة التالية

mL=1000 µL

volume of solute= 2.5×10^{-3} mL

$(\text{ppt})\left(\frac{V}{V}\right)=\frac{\text{V solute (mL)}}{\text{V solution (sample)(mL)}}\times10^{3}$	$(\text{ppm})\left(\frac{V}{V}\right)=\frac{\text{V solute (mL)}}{\text{V solution (sample)(mL)}}\times10^{6}$	$(\text{ppb})\left(\frac{V}{V}\right)=\frac{\text{V solute (mL)}}{\text{V solution (sample)(mL)}}\times10^{9}$
$(\text{ppt})\left(\frac{V}{V}\right)=\frac{2.5\times10^{-3}\ \text{mL}}{3\ \text{mL}}\times10^{3}$	$(\text{ppm})\left(\frac{V}{V}\right)=\frac{2.5\times10^{-3}\ \text{mL}}{3\ \text{mL}}\times10^{6}$	$(\text{ppb})\left(\frac{V}{V}\right)=\frac{2.5\times10^{-3}\ \text{mL}}{3\ \text{mL}}\times10^{9}$
=0.833 ppt	**=833.333 ppm**	**=833333.3 ppb**

Exercises

1. 50 g of a 26% (w/w) solution was mixed together with 130 g of a 17% (w/w) solution. What is the percentage concentration by mass of the new solution?
2. What volume of water must be added to a 125 mL solution of ethanol to change its percentage volume from 40% (v/v) to 35% (v/v)? Give your answer to the nearest whole number.

The relationship between molarity, normality and part per million

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

$$\mathbf{N} = \frac{\mathbf{ppm}}{\mathbf{Eq.wt} \times \mathbf{1000}}$$

***Example*(8):-**(a) Calculate the molar conc. of 1.0 ppm solutions each of Li^{+} and Pb^{+2}.(b) What weight of $Pb(NO_3)_2$ will have to be dissolved in 1 liter of water to prepare a 100 ppm $Pb(NO_3)_2$ solution.(A.wt pb^{+2}=207g/mol, Li^{+}=6.94 g/mol, N=16g/mol, O=16 g/mol)(Mwt $Pb(NO_3)_2$= 331 g/mol)

Solution:

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

(a)

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

$$\mathbf{M_{Pb^{+2}}} = \frac{\mathbf{1.0}}{\mathbf{207} \times \mathbf{1000}} = \mathbf{4.83 \times 10^{-6}\ mole/L}$$

(b)

L=1000 ml

$$\mathbf{M = \frac{100}{331 \times 1000} = 0.000302\ mole/L}$$

$$\mathbf{M = \frac{wt}{M.wt} \times \frac{1000}{V\ (mL)}}$$

$$\mathbf{0.0000302 = \frac{wt}{331} \times \frac{1000}{1000}} \quad \mathbf{wt = 0.0999\ gm\ Pb(NO_3)_2}$$

Example (9): Calculate the molarity of a solution of $Pb(NO_3)_2$ to prepare a 100 ppm solution? (Mwt $Pb(NO_3)_2$= 331 g/mol)

***Solution*:-**

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

$\mathbf{M = \frac{100}{331 \times 1000}}$ = 3.02 x 10^{-4} mol/L

***Example*(10):-**The concentration of Zinc ion in blood serum is about (1ppm). Express this as meq/L? (Awt Zn^{+2}=65.4 g/mol)

***Solution*:-**

$$\textbf{Eq } (Zn^{+2}) = \frac{A.wt}{2} = \frac{65.4}{2} = 32.7$$

$$N = \frac{ppm}{Eq.wt \times 1000}$$

$$= \frac{ppm}{\frac{A.wt}{2} \times 1000} = \frac{1}{32.7 \times 1000} = 3.06 \times 10^{-5}\ Eq/L$$

Eq=1000 meq

$$= 3.06 \times 10^{-5} \times 1000 = 3.06 \times 10^{-2}\ meq/L$$

The relationship between molarity and normality with percentage concentration

النسبة المؤوية w/v % يمكن ربطها بقوانين اخرى مثل قانون المولارية عن طريق ترتيب القانون كما في المثال التالي **القانون حفظ هو**

$$\mathbf{M = \frac{wt}{V} \times \frac{1000}{M.wt}}$$

***Example* (11):-**Calculate the molar concentration for 0.85% (w/v %) sodium chloride solution.(Mwt NaCl = 58.5 g/mol)

***Solution*:-**

$$0.85\%(w/v\ \%) = \frac{0.85}{100}$$

$$\mathbf{M = \frac{wt\ (g)}{M.wt} \times \frac{1000}{V\ mL}}$$

اعادة ترتيب القانون

$$\mathbf{M = \frac{wt}{V} \times \frac{1000}{M.wt}}$$

$$\mathbf{= \frac{0.85}{100} \times \frac{1000}{58.5} = 0.145M}$$

***Example* (12):-**Change 0.1M of NaCl to (w/v %) ? (Mwt NaCl = 58.5 g/mol)

***Solution*:-**

$$\mathbf{M = \frac{wt\ (g)}{M.wt} \times \frac{1000}{V\ mL}}$$

اعادة ترتيب القانون

$$\mathbf{M = \frac{wt}{V} \times \frac{1000}{M.wt}}$$

$$0.1\ mol/L = \frac{wt}{V} \times \frac{1000}{58.5\frac{g}{mol}} \Longrightarrow \frac{wt}{V} = \frac{0.1*58.5}{1000} = 0.00585 g/L$$

هذه النسبة $\frac{wt}{V}$ نضربها في 100 للحصول على النسبة المؤوية

$$\frac{wt}{V}\% = 0.00585*100 = 0.585\%$$

مسائل التمارين غير المحلولة ومسائل اضافية

ملاحظات للحل

اذا ذكر في السؤال ايونات مثل Cl^-, Na^+, Pb^{+2}, K^+ وغيرها واملاح مثل $NaCl$, $Pb(NO_3)_2$, KIO_3 وغيرها ولدينا في السؤال ppm ويريد M او وزن او حجم

نستعمل القوانين التالية عند الحل بالتسلسل التالي :

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

2- علاقة مول بمولارية

3- $M = \frac{wt}{M.wt} \times \frac{1}{V\ (L)}$

***Example* (13):-**One liter of a 500 ppm solution of $KClO_3$ contains how many grams of K^+? **(Mwt KIO3=123 g/mol, K=39 g/mol)**

***Solution*:-**

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

$$\mathbf{M}_{KClO3} = \frac{\mathbf{500}}{\mathbf{123} \times \mathbf{1000}} = \mathbf{0.00406\ mole/L}$$

$$KClO_3 \longrightarrow \mathbf{K^+} + \mathbf{ClO3^-}$$

$\mathbf{0.00406\ M}$ $\mathbf{0.00406M}$

$$\mathbf{M}_{K+} = \frac{\mathbf{wt}}{\mathbf{M.wt}} \times \frac{\mathbf{1}}{\mathbf{V\ (L)}}$$

$$\mathbf{0.00406} = \frac{\mathbf{wt}}{\mathbf{39}} \times \frac{\mathbf{1}}{\mathbf{1}}$$

$$\mathbf{wt = 0.158\ g}\ \boldsymbol{K^+}$$

***Example*(14):-** What weight of $PbCl_2$ will have to be dissolved in 2 litter of water to prepare a 150 ppm pb^{+2} solution.(A.wt pb^{+2}=207g/mol)(Mwt PbCl2= 278 g/mol)

Solution:

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

$$\mathbf{M}_{\mathrm{pb+2}} = \frac{\mathbf{150}}{\mathbf{207} \times \mathbf{1000}} = \mathbf{0.00072\ mole/L}$$

Pb^{+2} ⟶ **$PbCl_2$**

0.0072M **0.00072M**

$$\mathbf{M}_{\mathrm{PbCl2}} = \frac{\mathbf{wt}}{\mathbf{M.wt}} \times \frac{\mathbf{1}}{\mathbf{V\ (L)}}$$

$$\mathbf{0.00072} = \frac{\mathbf{wt}}{\mathbf{278}} \times \frac{\mathbf{1}}{\mathbf{2}}$$

$$\mathbf{wt} = 0.40032\ \mathrm{g\ PbCl2}$$

***Example*(15):-** You want to prepare 1L of a solution containing 1ppm Fe^{+2}. How many grams ferrous ammonium sulfate, Fe $SO_4(NH_4)_2$ $SO_4.6H_2O$, must be dissolved and diluted in 1L?What would be the molarity of this solution?(Mwt $FeSO_4(NH_4)_2SO_4.6H_2O$ = **392** g/mol)(Awt Fe^{+2}=56 g/mol)

Solution:

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

$$\mathbf{M_{Fe+2}} = \frac{\mathbf{1}}{\mathbf{56} \times \mathbf{1000}} = \mathbf{0.0000178\ mole/L}$$

Fe^{+2} ⟶ $FeSO_4(NH_4)_2SO_4.6H_2O$

0.0000178M 0.0000178 M

molarity of this solution is molarity of $FeSO_4(NH_4)_2SO_4.6H_2O$ = 0.0000178 M

$$\mathbf{M_{FeSO4(NH4)2SO4.6H2O}} = \frac{\mathbf{wt}}{\mathbf{M.wt}} \times \frac{\mathbf{1}}{\mathbf{V\ (L)}}$$

$$\mathbf{0.0000178} = \frac{\mathbf{wt}}{\mathbf{392}} \times \frac{\mathbf{1}}{\mathbf{1}}$$

$$\mathbf{wt} = 0.00699\ \text{g}\ \ \text{FeSO4(NH4)2SO4.6H2O}$$

***Example*(16):-** How many grams MgCl2 should be weighed out to prepare 3L of a 175 ppm solution of Cl^- (A.wt Cl^- =35.5g/mol) (Mwt MgCl2= 95 g/mol)

Solution:

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

$$\mathbf{M_{Cl-}} = \frac{\mathbf{175}}{\mathbf{35.5} \times \mathbf{1000}} = \mathbf{0.00492\ mole/L}$$

2 Cl- ⟶ **1 $MgCl_2$**

0.00492 M ⟶ **Y**

2 ⟶ **1**

$$\mathbf{Y} = \frac{\mathbf{0.00492}}{\mathbf{2}} = \mathbf{0.00246\ M\ MgCl_2}$$

$$\mathbf{M_{MgCl2}} = \frac{\mathbf{wt}}{\mathbf{M.wt}} \times \frac{\mathbf{1}}{\mathbf{V\ (L)}}$$

$$\mathbf{0.00246} = \frac{\mathbf{wt}}{\mathbf{95}} \times \frac{\mathbf{1}}{\mathbf{3}}$$

$$\mathbf{wt} = 0.7011\ \text{g}\ \mathbf{MgCl2}$$

Problems

1. Change 0.2 M of $FeCl_3$ to (w/v %) ?
2. Change 0.2 M of Fe_2O_4 to (g/ml) ?
3. Calculate the molar concentration of 1 ppm solutions of each of the following?

a) $AgNO_3$ b) $Al(SO_4)_3$ c) CO_2 d) $HClO_4$

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

a) Ca^{+2} b) $CaCl_2$ c) HNO_3 d) KCN

5. How many grams NaCl should be weighed out to prepare 1L of a 100 ppm solution of **(a) Na^+ and (b) Cl^-**
6. Calculate the weight percentage of solution prepare by mixing 3.5 g $CaCO_3$ with

a) 50 mL Acetone (density 0.789 g/cm^3). b) 200 mL Chloroform (density 1.45 g/cm^3).

7. A 2.5 g of $AgNO_3$ dissolved in 50 Kg water calculate: **a) wt/wt% , b) ppm**
8. A water supply has 10 ppb of arsenic. How many micrograms of arsenic are in 500 liters of water?
9. **Calculate weigh of Pb in (g) for 400 (µg/g) which contain 0.24 g glucose solutions Sample?**
10. A 2 kg of rock stone contain 0.005 g gold. What is concentration of gold in PPM, ppb, ppt?
11. What is the concentration, in ppb, and w/w% if 0.025 ng of KCl is dissolved in 100 Kg of water?