Useful Equations and Conversions

Henderson–Hasselbalch equation

$$\mathrm{pH} = \mathrm{p}K_a + \log \frac{\text{fraction neutralized}}{\text{fraction unneutralized}}$$

$$\mathrm{pH} = \mathrm{p}K_w - \mathrm{p}K_b + \log \frac{\text{fraction unneutralized}}{\text{fraction neutralized}}$$

Beer's law

$$A = \epsilon bc = \log \frac{1}{\%T/100} = 2 - \log \%T$$

Faraday's law

$$w = \frac{i \times t \times \text{equiv wt}}{F}$$

Molarity

$$\mathrm{M} = \frac{\text{moles of solute (mole)}}{\text{liter (L)}} = \frac{\text{millimoles of solute (mmole)}}{\text{milliliter (mL)}}$$

Normality

$$\mathrm{N} = \frac{\text{equivalents (eq)}}{\text{liter (L)}} = \frac{\text{milliequivalents (meq)}}{\text{milliliter (mL)}}$$

Assay

$$\%\,\mathrm{A} = \frac{\mathrm{mL_B} \times F_B \times \text{reaction ratio} \times \text{formula wt of A (mg/mmole)} \times 100}{\text{sample wt (mg)}}$$

Parts per Million	*Parts per Billion*	*Percent*
10,000 ppm		1.0%
1,000 ppm	1,000,000 ppb	0.1%
100 ppm	100,000 ppb	0.01%
10 ppm	10,000 ppb	0.001%
1 ppm	1,000 ppb	0.0001%
0.1 ppm	100 ppb	0.00001%
0.01 ppm	10 ppb	0.000001%

grams/milliliter (g/mL) = milligrams/microliter (mg/μL)

micrograms/milliliter (μg/mL) = nanograms/microliter (ng/μL)

parts per million (ppm)
= micrograms/gram (μg/g)
= micrograms/milliliter (μg/mL)
= nanograms/milligram (ng/mg)
= picograms/microgram (pg/μg)
= 10^{-6}

parts per billion (ppb)
= nanograms/gram (ng/g)
= nanograms/milliliter (ng/mL)
= picograms/milligram (pg/mg)
= 10^{-9}

Composition of Concentrated Reagent-Grade Acids and Ammonium, Potassium, and Sodium Hydroxide Solutions

Concentrated Reagent	*Formula*	*Formula Weight*	*Approximate Strength*[a] *(% w/w)*	*Assay Limits (% w/w)*	*Molarity (M)*	*Quantity To Prepare 1 L of 1 M Solution*[b] *(mL)*	*Normality (N)*	*Quantity To Prepare 1 L of 1 N Solution*[b] *(mL)*
Acetic acid	CH_3COOH	60.05	99.8	≥99.7	17.4	57.5	17.4	57.5
Formic acid	HCOOH	46.03	90.0	88.0–96.0	23.6	42.5	23.6	42.5
Hydrochloric acid	HCl	36.46	37.2	36.5–38.0	12.1	82.5	12.1	82.5
Hydrofluoric acid	HF	20.01	49.0	48.0–51.0	28.9	34.5	28.9	34.5
Nitric acid	HNO_3	63.01	70.0	68.0–70.0	15.9	63.0	15.9	63.0
Perchloric acid	$HClO_4$	100.46	70.5	69.0–72.0	11.7	85.5	11.7	85.5
			61.3	60.0–62.0	9.5	105.5	9.5	105.5
Phosphoric acid	H_3PO_4	98.00	85.5	≥85.0	14.8	67.5	44.4	22.5
Sulfuric acid	H_2SO_4	98.08	96.0	95.0–98.0	18.0	55.5	36.0	28.0
Ammonium hydroxide	as NH_3	35.05	29.0	28.0–30.0	14.5	69.0	14.5	69.0
Potassium hydroxide	KOH	56.11	45.0	≥85.0	11.7	85.5	11.7	85.5
Sodium hydroxide	NaOH	40.00	50.5	≥97.0	19.4	51.5	19.4	51.5

[a]Representative value.

[b]Rounded to nearest 0.5 mL.

Source: Reproduced courtesy of Mallinckrodt Baker, Inc.