Making Standarized Solutions

January 17, 2018 11:11 PM

→ Lab 20G.

Making Standardized Solutions

How could you make 1.0L of a 0.50M solution of NaOH in the lab? NaOH originates as solid white pellets.

Molarity $= \frac{n}{V} = \frac{\text{moles}}{\text{Litre}}$ ← How much (many moles) of NaOH do we need?

$n = (0.50M)(1.0L) = 0.50$ mol of NaOH

mass of NaOH: $\frac{0.50M \mid 40.0g}{\mid 1 mol} =$ **20.0g NaOH**

Method:
1. weigh out the exact mass of solid
2. put in 1.0L volumetric Flask
3. Fill ½ way + shake to mix. (dissolve)
4. then fill to Line (volumetrick flasks are precisely marked)

This method, though sound for making many types of solutions, would actually produce an NaOH solution that is slightly less than 0.50M (probably about 0.48M). This is because NaOH pellets actually absorb water, and so the mass of NaOH you measure is not all due to NaOH; some is due to water absorbed onto the pellets. This problem is the case for many acids and bases, which makes it very hard to create an accurate standardized solution from scratch. These acids and bases are **hygroscopic**, meaning that they absorb water.

some is due to H_2O

There are a few acids and bases that are **non-hygroscopic**, meaning they are pure and dry acids or bases and can be used to make solutions with accurate concentrations. Non-hygroscopic acids and bases are known as **primary standards**, and are used to make standardized solutions.

- No H_2O
- most accurate concentration

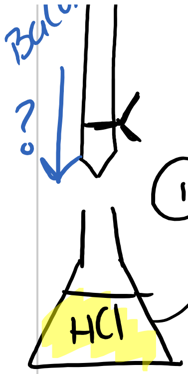
Examples: Primary Standard Base: sodium carbonate (Na_2CO_3)
Primary Standard Acids: potassium hydrogen phthalate (KHP) ← in Lab 20G.
oxalic acid ($H_2C_2O_4$)

Once a primary standard of known concentration is accurately prepared in the lab, it can be used to **standardize** any other acid or base solution by titration. For example, oxalic acid is a primary standard acid, and once an accurate standardized solution of it is prepared (using your method from the top of the page), it can be used to standardize any basic solution by titration. Then, that same basic solution that is now standardized can be used to titrate an unknown concentration of any acid, thereby standardizing that acid solution, and so on.

→ To find an exact, accurate [conc.] of an unknown

$Ba(OH)_2$ $H^+ = H_3O^+ =$ acid mol $OH^- =$ mol H_3O^+ $M = \frac{n}{V}$ $\therefore V = \frac{n}{M}$

Calculating Unknown Volume by Titration



$H^+ = H_3O^+$ = acid

Calculating Unknown Volume by Titration

What volume of 0.0350M $Ba(OH)_2$ will be required to neutralize 50.0mL of 0.0275M HCl?

$M = \frac{n}{V}$ ∴ $V = \frac{n}{M}$

(1) $HCl \rightarrow H^+ + Cl^-$

0.0275M ∴ 0.0275M

mol H^+ = (0.0275M)(0.0500L)

mol H^+ = 0.001375

(2) ∴ 0.001375 mol of OH^- need to be added to neutralize

$Ba(OH)_2 \rightarrow Ba^{2+} + 2OH^-$

6.875×10^{-4} mol ← ÷2 ← 0.001375

volume req'd = $\frac{6.875\times10^{-4} \text{ mol } Ba(OH)_2}{0.0350M}$

= 0.0196L or 19.6 mL of $Ba(OH)_2$

Assignment 13: Hebden p.158 #96, 97, 106, p.165 #122

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