Neutralization Reactions: Acid/Base Stoichiometry FTW!

Neutralization reaction: when an Arrhenius acid and base react to produce a salt and water

- These reactions will go to completion if the acid **and/or** the base is strong.
- Thus, these are NOT equilibrium calculations: no RICE needed!

Acid/base titrations are neutralization reactions: at the equivalence point, the moles of acid and base are stoichiometrically equal, and thus have completely neutralized each other!

Monoprotic Neutralization Reactions: 1:1 Stoich (Oh Happy Days!)

There are two methods to solve calculations of this type;

1. **Stoichiometry Method** (especially useful if acid and/or base is given as a solid)
2. **Shortcut** (easily used when both acid and base are aqueous solutions, like during a titration!)

$$M_a V_a = M_b V_b$$

Why does this shortcut work? Because when an acid and base have completely neutralized each other,

$$M_a V_a = \text{moles(acid)} = \text{moles}(H^+) = \text{moles}(OH^-) = \text{moles(base)} = M_b V_b$$

Let's Practice!

1. Calculate the volume in milliliters of a 5.0 M solution of HF needed to neutralize 6.2 g of NaOH.
   a. Which method is most useful here? Stoich! (base is solid)
   b. Solve the problem. $HF_{(aq)} + NaOH_{(aq)} \rightarrow H_2O_{(\ell)} + NaF_{(aq)}$

$$6.2\text{ g NaOH} \times \frac{1\text{ mol NaOH}}{39.998\text{ g NaOH}} \times \frac{1\text{ mol HF}}{1\text{ mol NaOH}} = 0.16\text{ mol HF}$$

$$5.0\text{ M} = \frac{0.16\text{ mol}}{\text{L}}$$

$$\Rightarrow \text{L} = \frac{0.16\text{ mol}}{5.0\text{ M}} = 0.031\text{ L} = \boxed{31\text{ mL}}$$

2. In a titration, the equivalence point is reached when 45.2 mL of HBr with a pH of 1.47 is added to a 25.0 mL sample of LiOH solution. What is the initial concentration of the LiOH solution?
   a. Which method is most useful here? short-cut! (both sol'ns)
   b. Solve the problem. $[H_3O^+] = [HBr] = 10^{-pH} = 10^{-1.47} = 0.034\text{ M}$

$$M_a V_a = M_b V_b$$

$$(0.034\text{ M})(45.2\text{ mL}) = M_b(25.0\text{ mL})$$

$$M_b = \frac{(0.034)(45.2)}{25.0} = \boxed{0.061\text{ M LiOH}}$$