Neutral Territory

CST:
Chem 2.a
5a, d, f, g
9a

ChemCatalyst:

- What products are produced from $Mg(OH)_2$ + HCl?
- What happens when you add an acid to a base?

Milk of Magnesia (aka Mylanta) $Mg(OH)_2$ can reduce excess stomach acid, HCl.

Notes:

- What is the difference btwn strong acids + bases + weak acids + bases?

- Strong acids + strong bases fully dissociate (break apart into ions) in water * conduct electricity very well
  - ex: HCl (pH = 1) + NaOH (pH = 14)
- weak acids + weak bases do NOT fully dissociate in water
  - not all of their molecules break apart into ions, some stay intact
  - don't conduct electricity as well
  - ex: CH_3COOH (pH = 4) + NH_3 (pH = 11)

* Insert DEMO here!

- What happens when you mix an acid + base together?

- Neutralization reaction: a rxn in which an acid + a base react to form a neutral solution of salt (metal-nonmetal) + water
- ex:

$$\underset{\text{(acid)}}{HCl} + \underset{\text{(base)}}{NaOH} \rightarrow \underset{\text{(salt)}}{NaCl} + \underset{\text{(water)}}{H_2O}$$

$$HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$$

$$HF + NaOH \rightarrow NaF + H_2O$$

$$2HCl + Ca(OH)_2 \rightarrow 2CaCl_2 + 2H_2O$$

$$HNO_3 + HCl \rightarrow NR \text{ (no rxn = 2 acids together)}$$

* double replacement rxns
* MOLES of H^+ = MOLES of OH^-

Student Worksheet

Drip Drop

Name: _____

Period: _____ Date: _____

Purpose: This activity will introduce you to a laboratory procedure used to determine the concentration of an acid or a base.

Procedure:

1. Place 20 drops of HCl Solution A in a 50-mL beaker. Add one drop of phenolphthalein indicator.
2. Carefully add single drops of 0.10 M NaOH, counting them as you go. Swirl the solution after each drop. Keep adding drops until a faint pink color is observed. You may wish to place your beaker on a white background in order to see the color change better.
3. Record the number of drops required to turn the solution a faint pink color, in the table below.
4. When the indicator turns a faint pink color you have reached the **endpoint** of this procedure. At this point the number of moles of HCl is equal to the number of moles of NaOH in the solution. Use this information to calculate the concentration of HCl Solution A. Enter the concentration in the table below.
5. Repeat steps 1 through 4 for HCl Solution B.
6. Repeat steps 1 through 4 for HCl Solution C.

have each group do one solution then share data

HCl solution	Drops of 0.10 M NaOH added to neutralize	Calculated concentration of HCl
20 drops HCl Solution A	10	0.05 M
20 drops HCl Solution B	20	0.10 M
20 drops HCl Solution C	4	0.02 M

1. Which of the three HCl solutions is the least toxic? Explain how you know.

2. What is happening in the solution as you add sodium hydroxide?

becomes more neutral

3. How many moles of HCl are in 20 drops if the solution is 0.10 M? Assume that 20 drops of solution are approximately 1.0 mL.

mol = M × L
= 0.1 × .001 = .0001 mol

4. How many drops of 0.1 M NaOH would be required to neutralize 20 drops of 0.050 M HCl?

5. The table below describes an experiment similar to the one you just completed. The first column shows an initial volume of HCl solution with an unknown concentration. The second column shows the volume of 0.10 M NaOH that was added before the indicator turned pink, signaling the endpoint. Complete the table.

Initial volume of HCl	Volume of 0.10 M NaOH added	Total moles of NaOH	Total moles of HCl	Initial HCl concentration
1.0 L	1.0 L	0.10 moles	0.10 moles	0.10 M
100 mL	200 mL	0.020 moles	0.020 moles	0.20 M
50 mL	200 mL	.020 mol	.020 mol	0.40 M
50 mL	25 mL	0.0025 moles	0.0025 mol	0.050 M
100 mL	73 mL	0.0073 mol	0.0073 mol	0.073 M

start together

6. Suppose you have a NaOH solution and you want to find its concentration. You add drops of 0.35 M HCl to 100 mL of the NaOH solution. The endpoint of the procedure occurs after 82 mL of HCl have been added. What is the concentration of NaOH in the original solution?

$$M_1V_1 = M_2V_2$$

$$\frac{0.35M(82mL)}{100mL} = \frac{M_2(100mL)}{100mL}$$

$$M_2 = 0.29\,M$$

Making sense:
Describe how you determined the concentration of the NaOH solution in Problem 6.

If you finish early…
There are 20 drops in 1.0 mL. Determine the number of moles of HCl in 1 drop of each of the HCl solutions.

Making Sense Notes:

- What is a titration?

- an experiment that allows you to calculate the unknown concentration of an acid or base
  - if you keep track of the volume of the known & unknown solutions, you can figure out the unknown concentration
  - * when the moles of H^+ = moles of OH^- the rxn has reached the equivalence point (end point)
  - * use $M_1V_1 = M_2V_2$ equation to solve for the unknown concentration (M_2)
- ex: If 25mL of 0.50M HCl solution is required to titrate (neutralize) 62.0 mL of NaOH, what is the molarity of NaOH?

$$HCl + NaOH \rightarrow NaCl + H_2O$$

$$M_1V_1 = M_2V_2$$

$$\frac{(0.50M)(.025L)}{.062L} = \frac{M_2(.062L)}{.062L}$$

$$M_2 = 0.20M\ NaOH$$