Introduction

**Acids** and **bases** are compounds that dissolve in water to produce solutions that behave in predictable ways. Acids and bases can be identified by their **properties** (characteristics, ways they behave.) Though acids and bases may differ from each other in many ways, they share certain common properties. Acids make things taste **sour** (example, grapefruit juice), and bases make things taste **bitter** (example, soap). Both **conduct electricity**, so they are used to make batteries.

In these experiments, you will use **indicator dyes** to test whether solutions are acidic or basic. (Something which is basic is also called **alkaline**). Some tests use **litmus papers**, which will change color depending on whether the solution is acidic or alkaline.

Red/pink = acid  Blue = base

You will also test the effects of acids on certain metals and nonmetals. Finally, you will measure the concentration of an unknown acid by a lab test called **titration**.

Procedure

1. **Effect of Acids on Indicator Dyes**
   a. Place 3 -4 drops of 6M HCl (hydrochloric acid) solution) in 3 Chempate cavities.
      Test one with the red litmus paper—result: ____________________________
      Test one with the blue litmus paper—result: ____________________________
   b. Place a drop of Phenolphthalein on the acid in the third cavity.
      Record the color ____________________________

2. **Effect of Bases on Indicator Dyes**
   a. Place 3 -4 drops of 0.5M NaOH (sodium hydroxide) in 3 Chempate cavities.
      Test one with the red litmus paper—result: ____________________________
      Test one with the blue litmus paper—result: ____________________________
   b. Place a drop of Phenolphthalein on the acid in the third cavity.
      Record the color ____________________________
3. Effect of Acids on Metals

Use the spatula to place a small amount or piece in separate cavities of the Chempate each of these metals: iron, zinc, magnesium, copper.

Add 3 – 4 drops of HCl to cover each metal.

The reaction rate can be used to compare the activity of the metals. Notice how fast or slow is each reaction, and record the rates from most active to least active:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

4. Effect of Acids on Carbonates (non-metals)

Place a chip of calcium carbonate (CaCO₃) in a Chempate cavity.

Put 3 – 4 drops of HCl on it, and record what happens:

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Enrichment:

Put another chip of CaCO₃ in a cavity. Put 5 drops of limewater solution in the cavity next to it. As soon as you place 3 – 4 drops of HCl on the chip, cover it with the cap and gas delivery tube, and bend the gas delivery tube into the limewater. Record what happens:

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
5. Measuring the Concentration of an Acid by "Titration"

"Titration" is a method to find the **concentration** of a solution by using accurately measured volumes of acids and bases. The concentration is described by its **molarity (M)**. A “1.0M” solution means 1 mole of the substance in 1000 mL (1 kg) of water; 6M solution means 6 moles in 1000 mL; 0.5M means ½ mole in 1000 mL.

Normally, titration is done using **burettes**, but in this lab activity, you will use a drop-controlling bottle to make the measurements. The method will be the same, but this way is less accurate.

1. Holding the bottle vertically, place exactly 10 drops of the “unknown acid” in the large cavity of the Chemplate.
2. Add 1 drop of Phenolphthalein solution.
3. Now add 0.5M NaOH (sodium hydroxide), one drop at a time. Stir gently after each drop. If it does not stay pink, add another drop. Carefully count the drops as they are added.

   The base **neutralizes** the acid and will produce a permanent color change when happens. The Phenolphthalein will indicate when this occurs by staying pink.

4. The concentration of the acid can be compared with the known concentration of the base (0.5M) by comparing the relative number of drops.

   Drops of unknown acid : ____10____.
   Drops of 0.5M NaOH : ________

   **Calculate the concentration of the unknown acid:**

   \[
   \frac{\text{Number of drops of base}}{\text{Number of drops of acid}} = \frac{\text{Concentration of acid}}{\text{Concentration of base}}
   \]

   \[
   \frac{\text{Number of drops of base}}{\text{Number of drops of acid}} = \frac{\text{Concentration of acid}}{\text{Concentration of base}}
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