Acid Base Lab #1: Strong and Weak Acids and Bases; SC7b

Objectives:

1. Identify and distinguish between strong and weak acids and strong and weak bases.
2. Identify acids and bases as hydrogen—ion acceptors and hydrogen-ion donors.
3. Identify conjugate acid—base pairs in acid—base reactions.
4. Describe acid—base reactions by using hydrogen—ion transfer equations.
5. Explain the differences between strong and weak acids and bases by using equilibrium principles.

Background: You have seen that acids are substances that react with water to produce H ions in solutions. Similarly, bases are chemicals that react with water to produce OH ions. For example, you have already seen that when an acid like HC1 dissolves in water, it reacts by transferring a hydrogen ion to water according to the following equation: $HCl + H_2O \rightarrow H_3O^+ + Cl^-$ To what degree does this reaction proceed? Do all the molecules of HC1 react, or do only some of them transfer hydrogen ions while others remain intact? The purpose of this lab is to take a new look at acids and bases and classify them according to the Brønsted-Lowry theory. You have already acquired working definitions of acids and bases. Acids turn BTB yellow and produce hydrogen ions in solution. Bases turn BTB blue and produce hydroxide ions in solution. You will use BTB (bromthymol blue) and UI (universal indicator) as probes to classify solutions as acids and bases. Alternatively, you might also use LabQuest digital pH probes in place of the UI. You will review how to write net ionic equations to show how each substance transfers a hydrogen ion to or from water. You will learn to identify the acid-base conjugate pairs in hydrogen-ion transfer equations. You will then use the hydrogen carbonate ion, HCO_3^-, to investigate acid-base reactions and group acid solutions according to relative strengths. You will use your data to formulate the concept that acids and bases can be classified as both strong and weak, depending on their behavior.

Materials and Equipment:

- $NaHSO_4$
- $NaHCO_3$
- NaH_2PO_4
- Na_2HPO_4
- CH_3COONa
- Na_3PO_4
- $Ca(OH)_2$
- HNO_3
- HCl
- H_2SO_4
- NaOH
- KOH
- $NaHSO_3$
- CH_3COOH
- Na_2CO_3
- UI
- H_3BO_3
- $C_6H_8O_7$
- NH_4Cl
- NH_3
- BTB

Experimental/Data Page (transcribe the three data tables below unless copies are provided)

Part A: Acids and Indicators

Mix 1 drop of each indicated solution. Look carefully for similarities and differences to distinguish strong acids from weak acids.

	**********STRONG ACIDS**********				----------WEAK ACIDS----------		
1 drop each	hydrochloric HCl	nitric HNO_3	sulfuric H_2SO_4	2 drops HCl + 9 drops H_2O	ethanoic CH_3COOH	citric $C_6H_8O_7$	boric H_3BO_3
BTB							
Record the color							
UI *Record the color and the matching pH*							

Part B: Acids, Bases, and Indicators

Mix 1 drop of the indicator (BTB or UI) with 5 drops of each indicated solutions. Record your results.

5 drops each	$NaHSO_4$	NaOH	Na_2HPO_4	KOH	$NaHCO_3$	Na_2CO_3	NaH_2PO_4
BTB							
UI							

Record the color

Record the color and the matching pH

1 drop each	$NaHSO_3$	$Ca(OH)_2$	$NaCH_3COO$	Na_3PO_4	NH_3
BTB					
UI					

Record the color

Record the color and the matching pH

Post Lab Questions: Use what you learned in this lab to answer the following questions.

1. What are the limitations of using the color chart to identify the pH of each substance?

2. What does BTB indicate that all solutions in Part A can be classified as?

3. React each chemical with water and to show that the substance is either an acid or a base