Acids and Bases **Name**_____

Strong vs. Weak Acids and Bases

Read from **Lesson 3a:**Strong vs. Weak Acids and Bases in the **Chemistry Tutorial Section, Chapter 15** of **The Physics Classroom**

Introduction

- The strength of an acid or base refers to its degree of dissociation in water.
- **Strong acids/bases**: **Completely** dissociate into ions.
- **Weak acids/bases**: **Partially** dissociate, establishing an equilibrium between molecules and ions.

Strong Acids

- Donate protons (H^+) and fully dissociate in water. (No undissociated molecules remain.)
  - Example: $HCl(aq) + H_2O(l) \rightarrow H_3O^+(aq) + Cl^-(aq)$
- Their conjugate bases (e.g., Cl^-) are very weak and unlikely to receive protons.
- Reaction goes to completion (dominant forward reaction).
- Common Strong Acids: HCl, HBr, HI, $HClO_4$, $HClO_3$, HNO_3, H_2SO_4

Weak Acids

- Partially dissociate; equilibrium favors reactants. (Most molecules remain undissociated.)
  - Example: $HF(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + F^-(aq)$
- Their conjugate bases (e.g., F^-) are relatively strong proton acceptors.
- Reaction is reversible with a dominant reverse reaction.
- Some Weak Acids: Acetic acid $HC_2H_3O_2$, Carbonic acid H_2CO_3, Phosphoric acid H_3PO_4, Hydrofluoric acid HF

Strong Bases

- Fully dissociate into metal ions and OH^-. (No undissociated base remains.)
  - Example: $NaOH(aq) \rightarrow Na^+(aq) + OH^-(aq)$
- Common Strong Bases: Each is a hydroxide of an alkali metal or an alkaline earth metal. The strong bases are: LiOH, NaOH, KOH, RbOH, CsOH, $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$

Weak Bases

- Partially dissociate; equilibrium favors reactants.
- Act as proton acceptors (Bronsted-Lowry bases).
  - Example: $NH_3(aq) + H_2O(l) \rightleftarrows NH_4^+(aq) + OH^-(aq)$
- Common Weak Bases: Ammonia NH_3, methylamine CH_3NH_2, ethylamine $C_2H_5NH_2$, pyridine $C_5H_5NH_2$

Questions

1. Write the dissociation equations for the following acids or bases. State if the molecule is a strong or weak acid or strong or weak base.
   a. perchloric acid

   b. nitrous acid

   c. hydrazine (N_2H_4)

   d. rubidium hydroxide

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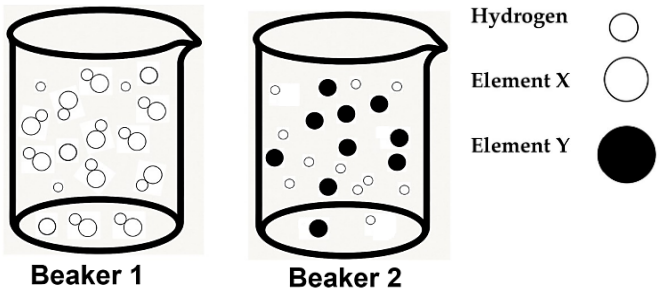
2. Molly Cule and Aaron Agin are discussing an image of two beakers, each containing a different acid. Aaron says, "Both beakers must contain strong acids because they both show hydrogen ions dissociated from the acid molecules." Is Aaron correct? If not, how could Molly explain why this reasoning is flawed?



For questions 3-7, consider these aqueous solutions at 25°C:

- Determine whether the solute is a strong acid or a strong base.
- Calculate the following properties *as applicable*: $[H^+]$, $[OH^-]$, pH, pOH, molarity of the solution, volume of the solution, mass of solute.

3. A solution of nitric acid contains **6.00 g of nitric acid** in **300.0 mL** of solution.
   a. Is this a strong acid or strong base?

   b. What is the **concentration** of the solution?

   c. What is the solution's **pH** and **pOH**?

4. Bo Rheim prepares a **0.10 M NaOH solution** for a titration lab.
   a. Is this a strong acid or strong base?

   b. What is the solution's **pH** and **pOH?**

   c. If he uses **2.00 g** of sodium hydroxide, what is the **volume** needed to make a **0.10 M solution**?

Acids and Bases

5. Hydrobromic acid plays a vital role in the manufacturing of flame-retardant material.
   a. Determine the **mass of hydrobromic acid** that must be added to **500.0 mL** of water to make a 0**.25 M** standardized solution.

   b. What is the solution's **pH** and **pOH**?

6. Calcium hydroxide is occasionally added during the pickling process to enhance the crunchiness of pickles.
   a. When added to a batch of pickles, the solution of calcium hydroxide has a **pH of 12.40**. Find the **hydroxide ion concentration** of the solution.

   b. Determine the **mass** of calcium hydroxide that must be used to make **1.00 L** of this solution.

7. Perchloric acid is commonly used in manufacturing components for fireworks due to its strong oxidizing properties. Suppose an industrial chemist needs to prepare **700.0 mL** of a **0.0044 M** perchloric acid solution.
   a. What **mass of perchloric acid** is required to make this solution?

   b. What is the **pH** of the resulting solution?