TOPIC 8
ACIDS AND BASES

8.2
Properties of Acids and Bases
ESSENTIAL IDEA

The characterization of an acid depends on empirical evidence such as the production of gases in reactions with metals, the color change of indicators or the release of heat in reactions with metal oxides and hydroxides.

NATURE OF SCIENCE (1.9)

Obtaining evidence for theories – observable properties of acids and bases have led to the modification of acid-base theories.
Both Acids and Bases

- Release ions in solution and therefore conduct electricity.
- React with one another and can form neutral solutions together.
- Affect the pH of a solution and thus cause pH indicators to change color.
- Highly acidic and highly basic solutions are VERY DANGEROUS to human health.
ACIDS

- Tart or sour taste
- Increase the concentration of $\text{H}_3\text{O}^+$
ACIDS

- React with B/L bases to produce salt and H₂O
  \[ \text{HCl}(aq) + \text{NaOH}(aq) \rightarrow \text{NaCl}(aq) + \text{H₂O}(l) \]
  
  Acid         Base         Salt         Water

- Produces hydrogen ions when dissolved in H₂O
# Naming Acids

HX (hydrogen and mono or polyatomic ion)

<table>
<thead>
<tr>
<th>Anion ending</th>
<th>Ex.</th>
<th>Acid Name</th>
<th>Ex.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ide</td>
<td>Cl-</td>
<td>hydro(stem)-ic acid</td>
<td>hydrochloric acid</td>
</tr>
<tr>
<td>-ite</td>
<td>SO(_3)(^{-2})</td>
<td>(stem)-ous acid</td>
<td>sulfurous acid</td>
</tr>
<tr>
<td>-ate</td>
<td>NO(_3)(^{-})</td>
<td>(stem)-ic acid</td>
<td>nitric acid</td>
</tr>
</tbody>
</table>
**Bases**

- Bitter taste and feels slippery
- (B/L Bases) React with acids to form salt + H₂O
  - Metal Oxides and hydroxides
  - Ammonia
  - Soluble carbonates (Na₂CO₃ and K₂CO₃)
  - Hydrocarbonates (NaHCO₃ and KHCO₃)
**BASES**

- Accept $\text{H}^+$ from acids
- Soluble bases that release $\text{OH}^-$ are known as alkalis (make alkaline solutions)
- All alkalis are bases, but not all bases produce the $\text{OH}^-$ ion so not all bases are alkalis.
**BASES**

- Reduce the $\text{H}_3\text{O}^+$ concentration ($\text{OH}^-$ ions interact with $\text{H}_3\text{O}^+$ to steal hydrogens)
NAMING BASES

Bases are ionic compounds and follow ionic compound naming rules.

NaOH – sodium hydroxide
Ca(OH)$_2$ – calcium hydroxide
Most acids have observable characteristic chemical reactions with reactive metals, metal oxides, metal hydroxides, hydrogen carbonates and carbonates.
Salt and water are produced in exothermic neutralization reactions.
APPLICATIONS/SKILLS

Be able to balance chemical equations for the reactions of acids.
REATIONS TYPES

1. An acid plus a base yields salt and water.
2. An acid plus a metal yields salt and hydrogen.
3. An acid plus a metal oxide yields salt and water.
4. An acid plus a carbonate yields salt plus water and carbon dioxide.
5. An acid plus a hydrogen carbonate yields salt plus water and carbon dioxide.
ACIDS PLUS BASES

- An acid plus a base yields salt and water.
- This is known as neutralization and will be studied with titration.
- This reaction is always exothermic.
- $\text{HCl} + \text{NaOH} \leftrightarrow \text{NaCl} + \text{H}_2\text{O}$
- The net ionic equation for a strong acid with a strong base is: $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}_{(l)}$
**ACIDS PLUS METALS**

- A metal mixed with an acid produces a salt and hydrogen gas.
- This is simply a single replacement reaction.
- \(2 \text{HCl} + \text{Zn} \rightarrow \text{ZnCl}_2 + \text{H}_2(\text{g})\)
- The net ionic equation is:
  - \(2\text{H}^+ + \text{Zn} \rightarrow \text{Zn}^{2+} + \text{H}_2\)
ACIDS WITH CARBONATES

- When you combine acids with carbonates, you get salt, water and CO₂.
- This is really a double replacement reaction yielding salt and carbonic acid, H₂CO₃, which ALWAYS decomposes to H₂O and CO₂.

2HCl + CaCO₃ → CaCl₂ + H₂CO₃

- 2HCl + CaCO₃ → CaCl₂ + H₂O + CO₂
- Net ionic: 2H⁺ + CO₃²⁻ → H₂O + CO₂
APPLICATIONS/SKILLS

Be able to identify the acid and base needed to make different salts.
Since an acid and a base react to form a salt and water, you can backtrack from the salt to determine which acid and base formed it.

- Split the ionic salt into its ions.
- Put $H^+$ with the anion to make the acid.
- Put $OH^-$ with the cation to make the base.

Salts can be neutral, acidic or basic.
Acids and bases can be distinguished using indicators.

Indicators are weak acids or bases whose conjugates have different colors.

Common examples are on page 21 of the data booklet.

The color change can be used to determine pH.
Neutralization reactions are used to determine the exact concentration of an acid or a base.

The equivalence point is where they exactly neutralize each other.

The end point is where the indicator changes color.

These reactions are always exothermic.