**Acids and Bases**

**Acids**

Acids are compounds that add H+ ions to water when in a solution.

- **HCl** — Hydrochloric acid: a very strong acid.

Many of our foods are acidic: citric (lemons; oranges); apples; tomato sauce. Acids taste sour and feel “squeaky” when you rub your fingers together.

**Bases**

Bases are compounds that add OH- ions to water when in a solution.

- **NaOH** — sodium hydroxide: a very strong base.

Many of our cleaning products are basic: ammonia (Windex); soap; bleach. Bases taste bitter and feel slippery.

**Strong acids and bases** — ionize almost completely in water, contributing many ions.

Strong acids and bases can burn your skin or eyes.

**Weak acids and bases** — ionize incompletely, contributing just a few ions.

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**pH—Measure of Acids and Bases**

<table>
<thead>
<tr>
<th>Strong acids</th>
<th>Acids</th>
<th>Weak acids</th>
<th>Neutral</th>
<th>Weak bases</th>
<th>Bases</th>
<th>Strong bases</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Concentrated HCl</td>
<td>Lemon juice</td>
<td>Vinegar</td>
<td>Distilled water</td>
<td>Baking soda</td>
<td>Bar soap</td>
<td>Ammonia</td>
</tr>
</tbody>
</table>

**Neutralization (Titration)**

When acids and bases are mixed they neutralize each other. If an equal concentration of acid and base are mixed they make neutral salt water.

Typical neutralization reaction

\[
\text{HCl} + \text{NaOH} \rightarrow \text{H}_2\text{O} + \text{NaCl}
\]

Acid + Base → Salt Water

“Neutralize that stomach acid” with an antacid—a base! Antacids are just bases.
Plants and animals need water close to neutral (pH 7) to survive.

Due to pollution from combustion reactions, rain today can be acidic. Rain less than pH 5.6 we call **acid rain**.

Acid rain can kill plants, cause asthma and other physical problems.

Acid rain also eats away statues and historical landmarks.

The Roman ruins, the pyramids of Egypt, and other treasures of the world are being slowly dissolved away by acid rain. More damage has been done in the last century than in the last 2,000 years.

Without stopping pollution (and acid rain) these treasures may be lost forever.

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1. Acid
   A. To mix acids and bases to cancel each other out and make salt water.
2. Base
   B. A compound that adds H+ ions to water.
3. Neutral
   C. Equal number of H+ and OH– ions; water is an example.
4. Neutralize
   D. A compound that adds OH– ions to water.
5. Acid Rain
   E. When pollution causes rain to be acidic (pH of less than 5.6).

Circle the acids and underline the bases.

<table>
<thead>
<tr>
<th>Acid</th>
<th>Base</th>
<th>Neutralize</th>
<th>Acid Rain</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCl</td>
<td>H2(CO3)</td>
<td>Mg(OH)2</td>
<td>H2(CO3)</td>
</tr>
<tr>
<td>H2(SO4)</td>
<td>NaOH</td>
<td>Ca(OH)2</td>
<td>NaOH</td>
</tr>
<tr>
<td>Ca(OH)2</td>
<td>H3PO4</td>
<td>HNO3</td>
<td>H3PO4</td>
</tr>
</tbody>
</table>

### Acids or Bases? (below)

<table>
<thead>
<tr>
<th>Property</th>
<th>HCl</th>
<th>H2(CO3)</th>
<th>H3PO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>1</td>
<td>1-7</td>
<td>1-2</td>
</tr>
<tr>
<td>OH– ions</td>
<td>Has fewer</td>
<td>Has more</td>
<td>Has more</td>
</tr>
<tr>
<td>H+ ions</td>
<td>Has more</td>
<td>Has fewer</td>
<td>Has fewer</td>
</tr>
<tr>
<td>Feels</td>
<td>Slippery</td>
<td>Sour</td>
<td>Sour</td>
</tr>
<tr>
<td>Tastes</td>
<td>Sour</td>
<td>Sour</td>
<td>Sour</td>
</tr>
</tbody>
</table>

Solution A (pH 4); Solution B (pH 2)

Which one has more H+ ions?
Which one has less OH– ions?

Solution A (pH 11); Solution B (pH 13)

Which one has more OH- ions?
Which one has less H+ ions?

Finish this neutralization reaction: (balance the salt, too).

HBr + Mg(OH) →

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**Circle the ones that are “Soluble”**.

- Saturated
- Nonpolar molecules
- Insoluble
- Dissolves in water
- Polar molecules
- Doesn’t dissolve in water

What type of compounds are soluble?

- CaO
- K2O
- Al2O3
- CO2
- NaF
- CO

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Classify these nuclear reactions as alpha α or beta β decay:

\[
\begin{align*}
^2\text{18}_8\text{Po} & \rightarrow ^{21}\text{4}_8\text{Pb} \\
^2\text{10}_8\text{Bi} & \rightarrow ^{21}\text{0}_8\text{Po}
\end{align*}
\]

You have 400 kg of a radioactive substance with a short half-life of 1,000 years. How much will be left after these times:

- 1,000 years
- 2,000 years
- 4,000 years

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