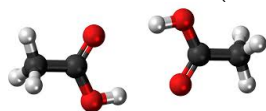## 12.4 - Strengths of Acids and Bases (Resources 8)

1. What makes an acid or base strong?

It's got nothing to do with whether it eats holes in things, or its concentration.

Strong acids or bases ionize completely in water and are good electrolytes; weak ones do/are not.
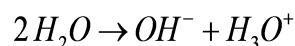
Demo - Class models acetic acid (5% ionized).

Acid Demo

Concentrated, strong acids are dangerous!
- Paper
- Sugar

Ion Product of Water

Water self-reacts to form a hydroxide ion (OH⁻) and a hydronium ion (H_3O^+):

$$2\,H_2O \rightarrow OH^- + H_3O^+$$

The concentration of these ions in pure water is low: 1.0 E -7 M.

pH

An expression of acidity:
Low pH = acidic,   high pH = basic.

Mathematically:

$$pH = -\log[H^+]$$

[H⁺] = hydrogen ion concentration (M).
Calculator Tutorial:
Press the (-) button.
Press the LOG button.
Enter hydrogen ion concentration.

2. pH Example A

What is the pH of a 0.03 M solution of HCl?

Find the concentration of hydrogen ions first.

HCl breaks up in a 1:1 ratio, so a 0.03 M solution of HCl yields a 0.03 M concentration of H⁺ and Cl⁻ ions.

$$pH = -\log[0.03] = 1.52$$

3. pH Example B

What is the pH of a 0.008 M solution of H_2SO_4?

Find the concentration of hydrogen ions first.

H_2SO_4 breaks up in a 2 H⁺:1 SO_4^{2-} ratio:
0.008 M H_2SO_4 yields a 0.016 M concentration of H⁺ ions.

$$pH = -\log[0.016] = 1.79$$

pOH

Like pH, but looks at hydroxide ion concentration.

Mathematically:
$$pOH = -\log[OH^-]$$

[OH⁻] = hydroxide ion concentration (M).

For any aqueous solution:
pH + pOH = 14.00.

4. pOH Example

What is the pOH of the solution in Example 2?
The pH was 1.79.

$$pH + pOH = 14.00$$
$$pOH = 14.00 - 1.79 = 12.21$$

Concentration

From pH or pOH, molar concentration is:

$$[H^+] = 10^{-pH} \quad \text{Or:} \quad [OH^-] = 10^{-pOH}$$

Calculator Tutorial:
Press 2nd , then the LOG button (10ˣ function).
Press the (-) button.
Enter pH (or pOH).

5. Molarity from pH Example

What is HNO_3 molarity if pH = 2.5 ?

$$[H^+] = 10^{-pH} = 10^{-2.5} = 0.0032\,M$$

Salt Hydrolysis.

Salts form acidic, basic or neutral solutions in water.

Weak acids and <u>strong</u> bases make basic salts,

<u>Strong</u> acids and weak bases make acidic salts.

Neutral salts: equally strong (or weak) acids and bases.

As they dissolve, they <u>hydrolyze</u> water (break it apart),

releasing or combining with H⁺ or OH⁻ ions.

Ex: Sodium fluoride (NaF) is a basic salt because it's
made from NaOH (strong base) and HF (weak acid).

Na F   H OH

6. Parent Chemical Example

What are the parent chemicals of $ZnSO_4$?
Will it be acidic, basic or neutral in water?

$Zn(OH)_2$ (weak base), and H_2SO_4 – (strong acid).

It forms an acidic solution.

Homework
12.4 Problems.
Due: Next Class.