Target: I can name strong acids and bases, and can explain the connection between the self ionization of water and pH

N-47

Acid/Base Nomenclature and Self Ionization of Water

Link to YouTube Presentation: https://youtu.be/fIhNYTAmgYk

Acid Nomenclature

Binary acid:

Hydrogen + highly electronegative element

Steps to Name:

1) Begins with **hydro**
2) Add the **root of the other element**
3) Add **–ic**
4) + **acid**

HBr
Hydrobromic acid

HCl
Hydrochloric acid

HI
Hydroiodic acid

Acid Nomenclature

Oxyacids:

Hydrogen + oxygen + a third element

Steps To Name:

1) Begins with **Root of ion** (not H or O) (sometimes starts with **per-** or **hypo-**)
2) Add **–ic, or -ous**
3) + **acid**

Oxyacids Continued…

Names change a little depending on how many oxygens the anion comes with…

Anion ends with **–ate** → change ending to **–ic**

Anion ends with **–ite** → change ending to **–ous**

Anion has **extra O than –ate** → start with **Per-**

Anion has **fewer O than –ite** → start with **Hypo-**

Oxyacids Continued...

ClO^- less O version → **Hypo**chlorous Acid

ClO_2^- -ite version → Chlor**ous** Acid

ClO_3^- -ate version → Chlor**ic** Acid

ClO_4^- more O version → **Per**chloric Acid

Some names are a little off to make them sound better, easier to say:

Remember…

Phosphoric acid…not Phosphic acid

Sulfuric acid…not Sulfic acid

When writing formulas make them neutral! That is how you know how many hydrogens it has!

$H^{+} \quad (CO_3)^{2-} \rightarrow H_2(CO_3)$

They get weird really fast…

Focus on the patterns, just get used to the weird ones…

Naming Acids

Formula	Name
HF	Hydrofluoric acid
H_2S	Hydrosulfuric acid
HNO_3	Nitric acid
HNO_2	Nitrous Acid
H_2SO_4	Sulfuric acid

Strong Acids and Bases

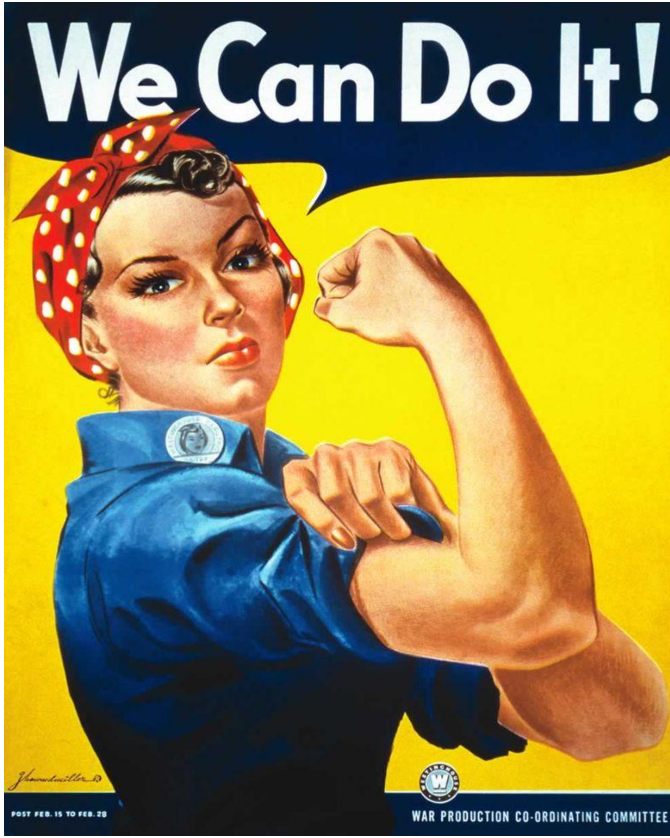
STRONG?

They dissociate "completely"

$HCl \rightarrow H^+ + Cl^-$

HCl is a strong acid so LOTS of ions in solution!

Strong Acids and Bases are the easy ones…assuming the dissociate completely makes our math easier ☺



MEMORIZE!

The Seven Strong Acids

1) HCl – Hydrochloric Acid
2) HBr – Hydrobromic Acid
3) HI – Hydriodic Acid

Binary Acids

4) H_2SO_4 – Sulfuric Acid
5) HNO_3 – Nitric Acid
6) $HClO_4$ – Perchloric Acid
7) $HClO_3$ – Chloric Acid

Oxyacids

MEMORIZE!

The Eight Strong Bases

They are all hydroxides!

1) LiOH – Lithium Hydroxide
2) NaOH – Sodium Hydroxide
3) KOH – Potassium Hydroxide
4) RbOH – Rubidium Hydroxide
5) CsOH – Cesium Hydroxide

Alkali Metals

6) $Ca(OH)_2$ – Calcium Hydroxide
7) $Sr(OH)_2$ – Strontium Hydroxide
8) $Ba(OH)_2$ – Barium Hydroxide

Alkaline Metals

Neutralization Reactions

What happens when you mix a strong acid and strong base?

It is always the same!

Acid + Base → Water + Ionic Salt

$HCl + NaOH \rightarrow H_2O + NaCl$

$H_2SO_4 + 2KOH \rightarrow 2H_2O + K_2SO_4$

Why is the pH of H_2O equal to 7?

Because water dissociates!

It "self ionizes" – not much…but it does!

$$H_2O_{(l)} + H_2O_{(l)} \leftrightarrow H_3O^+_{(aq)} + OH^-_{(aq)}$$

Conj. Acid + Conj. Base

Back to Equilibrium Chapter!

$$H_2O_{(l)} + H_2O_{(l)} \leftrightarrow H_3O^+_{(aq)} + OH^-_{(aq)}$$

Conj. Acid + Conj. Base

pH is a measure of ion concentration…

Dissociation is a reversible reaction…

So how do we find the [ ] of ions at equilibrium????

Equilibrium expressions!

Self Ionization of Water

What is the equilibrium expression for water?

$$H_2O_{(l)} + H_2O_{(l)} \leftrightarrow H_3O^+_{(aq)} + OH^-_{(aq)}$$

$$K_w = [H_3O^+][OH^-]$$

Remember!

Pure liquids aren't included in equilibrium expressions!

Self Ionization of Water

$[H_3O^+]$ and $[OH^-]$ are both equal to $1.0x10^{-7}$ M at 25^{o}C.

NOTICE ANYTHING???

$$K_w = [H_3O^+]\,[OH^-]$$

$$1.0x10^{-14} = [1.0x10^{-7}] \times [1.0x10^{-7}]$$

Self Ionization of Water

$$K_w = [H_3O^+] [OH^-]$$

$$1.0x10^{-14} = [1.0x10^{-7}] \text{ x } [1.0x10^{-7}]$$

The concentration of $[H_3O^+]$ and $[OH^-]$ are equal…
So it is neutral!

Also - The pH and the pOH of any aqueous solution are related through the K_w. That's why if you know one you can find the other! And why they add to 14…look at the exponents!

Self Ionization of Water

TABLE 8-1 Temperature Dependence of K_w

Temperature (°C)	K_w
0	0.114×10^{-14}
10	0.292×10^{-14}
20	0.681×10^{-14}
25	1.01×10^{-14}
30	1.47×10^{-14}
40	2.92×10^{-14}
50	5.47×10^{-14}
60	9.61×10^{-14}

Self Ionization of Water

Temperature Dependent

The Kw changes based on temperature.
In our practice problems we are always assuming it is at 25°C unless told otherwise

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THINK!

pH of water decreases as temperature increases ***BUT*** that does not mean it is "acidic" – there is STILL [H+] = [OH-], it's just that the number we call "neutral" and the concentrations of ions at that temp is different than when at 25°C, pH 7. ***A neutral pH is only 7 at 25° !!!***

K_w Calculations

What is the $[H^+]$ in an aqueous solution with a hydroxide ion concentration of 0.001 M at 25 °C?

(BTW…THIS ONLY WORKS FOR AQUEOUS AT 25 °C)

$$K_w = [H^+]\,[OH^-]$$

$$1.0\times10^{-14} = [1.0 \times 10^{-3}]\,[H^+]$$

$$\mathbf{[H^+] = 1 \times 10^{-11}\ M}$$

Video on Dissociation of Water

https://youtu.be/Xeuyc55LqiY

Fun way to remember MOST of the strong/weak Acids/Bases

Careful…it doesn't have ALL of them!

https://youtu.be/onGDi1KKjdM

Missing:

RbOH and CsOH

They are not as common so some people leave them off…

A good recap video – Crash Course

https://youtu.be/LS67vS10O5Y

A video about "buffers" and Acid Rain if interested…

https://youtu.be/8Fdt5WnYn1k

YouTube Link to Presentation

https://youtu.be/fIhNYTAmgYk