Acids

know 6 strong ones!
100% dissociate.

weak ones: all others!
<100% dissociation!

ex: $HF + H_2O \rightleftharpoons H_3O^+ + F^-$

BASES

Strong bases... typically alkali metal hydroxides, as well as $Ba(OH)_2$.

$\boxed{\text{100\% dissociate}}$

$LiOH$
$NaOH$
KOH
$RbOH$
$CsOH$ $Ba(OH)_2$

$\left.\begin{array}{l} Mg(OH)_2 \\ Ca(OH)_2 \\ Sr(OH)_2 \end{array}\right\}$ very low solubility :(

$LiOH \xrightarrow{100\%} Li^+(aq) + OH^-(aq)$

Most bases are weak... only partially ionize

ex: $NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

H^+ H

base (Bronsted) acid

conjugate a-b

What's pH of 5.0 mM HCl(aq)?

$pH = -\log_{10}[H^+]$

$(1.0\times10^{-7}M)$

$HCl(aq) + H_2O(l) \xrightarrow{100\%} H_3O^+(aq) + Cl^-(aq)$

	$HCl(aq)$	$H_2O(l)$	$H_3O^+(aq)$	$Cl^-(aq)$
I	$5.0\times10^{-3}M$	—	≈ 0	0
C	$-5.0\times10^{-3}M$	—	$+5.0\times10^{-3}M$	$+5.0\times10^{-3}$
E	0	—	$(5.0\times10^{-3}M)$	$(5.0\times10^{-3}M)$

2sf.

$pH = -\log[H^+] = -\log[5.0\times10^{-3}]$
$= 2.30$ 2dp

ex: What's pH of 5.0 mM $Ba(OH)_2(aq)$? @ 25°C

$$Ba(OH)_2(aq) \xrightarrow{100\%} Ba^{2+}(aq) + 2OH^-(aq)$$

$\sim 1.0\times10^{-7}$ M

	$Ba(OH)_2(aq)$	$Ba^{2+}(aq)$	$2OH^-(aq)$
I	5.0 mM	0	≈0
C	−5.0 mM	+5.0 mM	+10. mM
E	0	5.0 mM	10. mM

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

$pOH = -\log[OH^-] = -\log_{10}[10.\times10^{-3}]$

$= 2.00$

$pH + \underset{2.00}{pOH} = 14.00$

$\Rightarrow pH = 12.00$

Basic if pH > 7 (aq, 25°C)

$[H^+] = 10^{-pH} = 10^{-12.00}$

$= 1.0\times10^{-12}$ M

Weak Acids and Ka

└ Acid dissociation constant.

Most acids are weak ...

$$HA(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + A^-(aq)$$

H^+

$$\boxed{K_a = \frac{[H_3O^+][A^-]}{[HA]}}$$

large Ka = 'stronger' acid

small Ka = weaker acid

STRONGER

ex:		Ka
	HF	$K_a = 7.1\times10^{-4}$
formic acid →	HCO_2H	$= 1.7\times10^{-4}$
acetic acid →	CH_3CO_2H	$= 1.8\times10^{-5}$
phenol or carbolic acid. →	C_6H_5OH	$= 1.3\times10^{-10}$

WEAKER

Let's calculate pH of 0.50M $HF(aq)$ @25°C.

H^+

$K_a = 7.1\times10^{-4}$ (weak acid).

$$HF(aq) + H_2O(l) \xrightleftharpoons{} H_3O^+(aq) + F^-(aq)$$

H^+

I	0.50	—	≈0	0
C	−x	—	+x	+x
E	(0.50−x)	—	(x)	(x)

$$K_a = \frac{[H_3O^+][F^-]}{[HA]}$$

$$7.1\times10^{-4} = \frac{(x)(x)}{0.50-x}$$

Perhaps... $0.50 >> x$ or $\boxed{x << 0.50}$

then... $7.1\times10^{-4} \approx \frac{x^2}{0.50}$

$$\sqrt{7.1\times10^{-4}\times0.50} \approx \sqrt{x^2} = x$$

$\Rightarrow x \approx 0.0188$

$\Rightarrow [H^+] = x = 0.0188M$

small ... so perhaps assumption that $x << 0.50$ was valid.

5% rule

approx. is OK if there's < 5% dissoc.

$$\frac{[H^+]_{eq}}{[HA]_0}\times100 < 5\%$$

$$\Rightarrow \frac{0.0188M}{0.50M}\times100 = 3.8\% \checkmark$$

$pH = -\log[H^+] = -\log[0.0188M]$
$= 2.08$