Today, February 19th
↳ Lab Tomorrow: Expt. 9

Strong Acid:

$HBr + \boxed{H_2O \xrightarrow{100\%} H_3O^+} + Br^-$

↳ template

Weak Acid:

$HA + \boxed{H_2O \rightleftharpoons H_3O^+} + A^- \quad K_a^{HA} = \frac{[H_3O^+][A^-]}{[HA]}$

↳ template

Warm-up #1:

What is the pH of a 0.075 M HBr (strong acid) solution?

$[H_3O^+] = 0.075\ M$

$pH = -\log(0.075)$

$= 1.12$

Warm-up #2:

What is the pH of 0.050 M benzoic acid, solution $HC_7H_5O_2(aq)$ or "HBz" $K_a^{HBz} = 6.5 \times 10^{-5}$

$K_a^{HBz} = \frac{[H_3O^+][Bz^-]}{[HBz]} = 6.5 \times 10^{-5}$

	$HBz + H_2O \rightleftharpoons$	H_3O^+	$+ Bz^-$
I	0.050	0	0
C	$-x$	$+x$	$+x$
E	$0.050 - x$	x	x

$\rightarrow \frac{x^2}{0.050 - x} = 6.5 \times 10^{-5} \rightarrow \frac{x^2}{0.050} \approx 6.5 \times 10^{-5}$

$x = 1.80 \times 10^{-3}$

$[H_3O^+] = 1.8 \times 10^{-3}$

$\boxed{pH = 2.74}$

*"400-rule": Is $\frac{[HBz]_I}{K_a^{HBz}} > 400$, if so, x = small enough to drop!

(bigger, the better)

(smaller, the better)

$K_a = 1 \times 10^{-2}$
1×10^{-5}
1×10^{-8} ← BEST

Percent Dissociation $= 100\% * \frac{x}{[HBz]_I} = \boxed{3.6\%}$

What is the K_a of a weak acid that has a pH = 3.63 as a 0.200 M solution?

	$HA + H_2O \rightleftharpoons$	H_3O^+	$+ A^-$
I	0.200	0	0
C	$-x$	$+x$	$+x$
E	$0.200 - x$	x	x

$K_a = \frac{[H_3O^+][A^-]}{[HA]} = \frac{x^2}{0.200 - x} = \frac{(2.34 \times 10^{-4})^2}{0.200} = \boxed{2.7 \times 10^{-7}}$

*passes 400 rule!

$[H_3O^+] = 10^{-pH} = 10^{-3.63} = \boxed{2.34 \times 10^{-4}}$

$K_a = 2.7 \times 10^{-7}$ → $pK_a = -\log K_a = 6.561029996$

K_a has 2 sig figs which translates to 2 sig figs past the decimal!

$K_a = 10^{-pK_a}$

how much of # do I keep??

February 19th

Strong Acid

$HBr + H_2O \xrightarrow{100\%} H_3O^+ + Br^-$

↳ template!

Weak Acid ← template!

$HA + H_2O \rightleftharpoons H_3O^+ + A^- \quad K_a^{HA}$

Strong Bases: group I hydroxides

↳ LiOH, NaOH, KOH, etc.

$NaOH(aq) \xrightarrow{100\%} Na^+ + OH^-$

ex: what is the pH of a 2.7×10^{-4} M NaOH (aq) soln?

↳ strong base

$[OH^-] = 2.7 \times 10^{-4}$ M

$pOH = -\log(2.7 \times 10^{-4})$

$= 3.57$ → 7 sig figs!

$pH = 10.43$

Weak Bases:

$A^- + H_2O \rightleftharpoons OH^- + HA$

↑ weak base ↑ conjugate weak acid

↳ template!

$[H_3O^+] \text{ — } [OH^-]$

pH — pOH

$pH + pOH = 14.00$

→ what is the pH of a 0.32M F^- solution?

M	$F^- + H_2O \rightleftharpoons$	OH^-	+	HF	$K_b^{F^-} = \frac{[OH^-][HF]}{[F^-]}$
I	0.32	0		0	* passes 400 rule!
C	$-x$	$+x$		$+x$	$= \frac{(x^2)}{0.32-x} = 2.9 \times 10^{-11}$
E	$0.32-x$	x		x	

ε OH^-

$\frac{x^2}{0.32} = 2.9 \times 10^{-11}$

$\frac{[F^-]_I}{K_b} > 400?$ → $x = 3.04 \times 10^{-6}$ → $-\log(x)$ → 8.48

***conjugate weak acid + weak base pairs**

weak acid		conjugate weak base	
	← most acidic + lowest pH		
HF	$K_a^{HF} = 3.5 \times 10^{-4}$	F^-	$K_b^{F^-} = 2.9 \times 10^{-11}$
HBz	$K_a^{HBz} = 6.5 \times 10^{-5}$	Bz^-	$K_b^{Bz^-} = 1.5 \times 10^{-10}$
HOCl	$K_a^{HOCl} = 3.5 \times 10^{-8}$	OCl^-	$K_b^{OCl^-} = 2.9 \times 10^{-7}$

↑ best weak base, highest pH

Weak Acid

$HF + H_2O \rightleftharpoons H_3O^+ + F^- \quad K_a^{HF} =$

C. weak base

$F^- + H_2O \rightleftharpoons OH^- + HF \quad K_b^{F^-} =$

$HF + OCl^- \rightleftharpoons F^- + HOCl \quad K_c = ?$

↳ $HF + H_2O \rightleftharpoons H_3O^+ + F^- \quad K_a^{HF} = 3.5 \times 10^{-4}$

$OCl^- + H_3O^+ \rightleftharpoons H_2O + HOCl \quad K = 2.9 \times 10^{7}$

$2H_2O \rightleftharpoons H_3O^+ + OH^-$

$K_w = K_a^{HF} * K_b^{F^-}$

(in general...) $K_w = K_a * K_b$

$1.0 \times 10^{-14} = 3.0 \times 10^{-4} * K_b^{F^-}$

↳ $K_b^{F^-} = 2.9 \times 10^{-11}$

$K = 1 \times 10^{4}$