Lecture 11: Weak Acid Equilibrium and pH

Note Title 3/31/2011

Bottle Labels Lie!

Example. What is the pH of a 0.25M HF acid solution?

initial

	$HF_{(aq)}$ (acid)	+ $H_2O_{(l)}$ (base)	$\rightleftharpoons$ $H_3O^+_{(aq)}$ (acid)	+ F^- (basic)	$K_a = 3.5\times10^{-4}$ (small → favors reactants)
i	0.25M * (2 S.F.)	~	0 M	0 M	(2 S.F.)
c	$-x$		$+x$	$+x$	
e	$0.25-x$		x	x	

L.M.A. $K_a = \dfrac{[H_3O^+][F^-]}{[HF]}$ | $3.5\times10^{-4} = \dfrac{x\,x}{(0.25-x)}$ solve for x

$x \approx 0$

$3.5\times10^{-4} = x^2/0.25$

$x = 9.354\times10^{-3}$

s/. $\dfrac{9.354\times10^{-3}}{0.25}\cdot 100 = 3.74\% < 5\%$ ☺

$[HF]_{eq} = 0.25 - x \approx 0.24\,M$ (2 S.F.) ← Label 0.25M

$[H_3O^+] = x = 9.3\times10^{-3}\,M$ * (2 S.F.)

$[F^-] = x = 9.3\times10^{-3}\,M$ (2 S.F.)

exact

$pH = -\log[H_3O^+] = -\log(9.354\times10^{-3}) = 2.029 = 2.03$ (2 S.F. → 2 S.F.)

SF problem = # decimal digits in pH.