March 13, 2002

- ✓**Exam #2**
  - ✓TONIGHT!
  - ✓7 pm, Kalkin 001
- ✓**Demo on Friday!**

Successive Approximations?

$$\boxed{\frac{x^2}{1.0 \times 10^{-1} - \mathbf{x}} = 7.2 \times 10^{-4}}$$

Assume: $x \ll 1.0 \times 10^{-1}$

$$\boxed{\begin{gathered}\frac{(x')^2}{1.0 \times 10^{-1}} = 7.2 \times 10^{-4} \\ x' = 8.4853 \times 10^{-3}\end{gathered}}$$

First approximation

$$\frac{(x'')^2}{1.0 \times 10^{-1} - 8.4853 \times 10^{-3}} = 7.2 \times 10^{-4}$$

2nd approx

$$x'' = \mathbf{8.11730 \times 10^{-3}}$$

4.5% change - *Stop!*

$\boxed{pH = \mathbf{2.09}}$

Successful Successive Approximations?

- **Assess Assumptions:**
  1. $[H^+] << 1.0 \times 10^{-1}$ *M*

     close . . . But should be *100x* difference
  2. We can ignore $[H^+]_{H2O}$
     - ✓ $[H^+] >> [H^+]_{H2O}$
- **When do we include** $[H^+]_{H2O}$?
  - ✓ *Dilute* solutions
  - ✓ *Very* weak ($K_a < 10^{-8}$) acids

What about Bases?

- Treat Bases *just like acids* **except:**
  - ✓Use K_b instead of K_a
  - ✓Calculate $[OH^-]$ first, convert to pOH
  - ✓Calculate pH from pOH
- ✓Examples
  - ✓pH of 0.10 *M* NaOH (strong base)
  - ✓pH of 0.10 *M* Methylamine (weak base) (CH_3NH_2 - $K_b = 4.38 \times 10^{-4}$)

Here's Another One!

- **Calculate the pH of a 0.10 *M* KCN solution** (K_a (HCN) = 6.2×10^{-10}).

What happens to KCN in water?

$$KCN \rightarrow K^+ + CN^-$$

conjugate base of HCN

So, the pH-determining species is a ***base***: CN^-

Find K_b for CN^-: $K_aK_b = K_w$ $K_b = K_w/K_a$

$$K_b = \frac{1.0 \times 10^{-14}}{6.2 \times 10^{-10}} = \mathbf{1.613 \times 10^{-5}}$$

ICE Table

	CN^- (aq) + H_2O (l) ⇆	HCN (aq) +	OH^- (aq)
I	0.10	0	0
C	-x	+x	+x
E	0.10 - x	x	x

<u>Substituting:</u> $K_b = \frac{[HCN][OH^-]}{[CN^-]} = 1.613 \times 10^{-5}$

$$\boxed{\frac{x^2}{0.10 - x} = 1.613 \times 10^{-5}}$$

Quadratic Equation?

Successive Approximations?