

March 13, 2002

✓ Exam #2

✓ TONIGHT!

✓ 7 pm, Kalkin 001

✓ Demo on Friday!

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Successive Approximations?

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

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

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

First approximation

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

2nd approx

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

$$\text{pH} = \underline{2.09}$$

4.5% change - Stop!

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Successful Successive Approximations?

➤ **Assess Assumptions:**

1. $[H^+] \ll 1.0 \times 10^{-1} M$
close . . . But should be 100x difference
2. We can ignore $[H^+]_{H_2O}$
✓ $[H^+] \gg [H^+]_{H_2O}$

➤ **When do we include $[H^+]_{H_2O}$?**

- ✓ Dilute solutions
- ✓ Very weak ($K_a < 10^{-8}$) acids

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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**

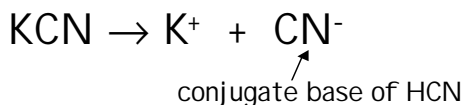
- ✓ pH of 0.10 M NaOH (strong base)
- ✓ pH of 0.10 M Methylamine (weak base)
($CH_3NH_2 - K_b = 4.38 \times 10^{-4}$)

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Here's Another One!

- Calculate the pH of a 0.10 M KCN solution ($K_a(\text{HCN}) = 6.2 \times 10^{-10}$).

What happens to KCN in water?



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

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

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

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ICE Table

	$\text{CN}^- (\text{aq}) + \text{H}_2\text{O} (\text{l}) \rightleftharpoons \text{HCN} (\text{aq}) + \text{OH}^- (\text{aq})$	
I	0.10	0 0
C	<u>-x</u>	<u>+x</u> <u>+x</u>
E	0.10 - x	x x

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

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

Quadratic Equation?
 Successive
 Approximations?

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