March 4, 2002

- ✓ ***No Labs This Week!***
- ✓ **Exam #2**

  Conflict? Email me *this week* to schedule alternate time
- ✓ **Problem Session**

  Put problems/question in box or email me or just show up today with questions!
- ✓ **Chapter 16 Problems**

  Part 1 of solutions are ***now online*** (questions 1-31)

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Water Logged

- We can define other log functions:

$$pOH = -\text{Log}[OH^-]$$

$$pK_w = -\text{Log}K_w = \mathbf{14.00}$$

- We can quantify the *autoionization* of water entirely in logs:

$$\mathbf{pK_w = pH + pOH}$$

So, at 25 ^oC:

$$\boxed{\mathbf{pH + pOH = 14.00}}$$

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Example

- What is the pH of an aqueous solution in which [OH-] = 1.0×10^{-10} *M* ?

$K_w = [H^+][OH^-] \Rightarrow [H^+] = \frac{K_w}{[OH^-]} = \frac{1.0 \times 10^{-14}}{1.0 \times 10^{-10}} = 1.0 \times 10^{-4}$ *M*

So: **pH** = $-\text{Log}(1.0 \times 10^{-4})$ = ***4.00***

It's easier with logs!

pOH = $-\text{Log}(1.0 \times 10^{-10})$ = 10.00

So: pH = 14.00 - pOH = 14.00 - 10.00 = ***4.00***

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K_a and K_b

For *acid dissociation:*

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

We define an *acid dissociation constant:*

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

Similarly, for a *base:*

$$B\ (aq) + H_2O\ (l) \leftrightarrows BH^+\ (aq) + OH^-\ (aq)$$

Where:

$$K_b = \frac{[OH^-][BH^+]}{[B]}$$

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Acid (Base) *Strength*

- Magnitude of K_a (or K_b) indicates *degree of dissociation*
  - As K_a *increases,* the degree of dissociation *increases*
  - Increased dissociation = ***more* H^+**
  - **SO:** as K_a increases, acid strength increases

Example:

Acetic Acid - CH_3COOH ($K_a \approx 10^{-5}$)
is *stronger* than
Hydrocyanic Acid - HCN ($K_a \approx 10^{-9}$)

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Conjugate Acid/Base Pairs

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

$$A^-\ (aq) + H_2O\ (l) \leftrightarrows HA\ (aq) + OH^-\ (aq)$$

$$H_2O\ (l) + H_2O\ (l) \leftrightarrows H_3O^+\ (aq) + OH^-\ (aq)$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} \qquad K_b = \frac{[OH^-][HA]}{[A^-]}$$

$$\boxed{K_a K_b = K_w} \text{ OR } \boxed{pK_w = pK_a + pK_b}$$

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