Unit 10.3: Calculating pH

I. **Water Dissociation**

* **Water \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: H2O(l)  →  H+(aq) + OH-(aq)**
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ constant, KW = [H+][OH-] / [H2O]**

**Note:**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is not involved in the equilibrium expression because it is a pure liquid, also, the amount of water not dissociated is so large compared to that dissociated that we consider it a constant

* **Value for Kw = [H+][OH-] = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* Note: The reverse reaction, H+(aq) + OH-(aq)  →   H2O(l)

**is not** equal to 1 x 10-14

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for pure water = 1 x 10-7
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for pure water = 1 x 10-7
* Definitions of acidic, basic, and neutral solutions based on [H+]
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: if [H+] is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** than 1 x 10-7 M
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: if [H+] is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** than1 x 10-7 M
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: if [H+] if **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to 1 x 10-7 M

 **Example 1**

* What is the [H+] of a sample of lake water with [OH-] of \_\_\_\_\_\_\_\_\_ x 10-9 M? Is the lake acidic, basic, or neutral?
* **Solution:** [H+] = 1 x 10-14 / 4 x 10-9 = 2.5 x 10-6 M
* Therefore the lake is slightly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **Remember:** the smaller the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ exponent, the larger the number is.
* Therefore:
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ solutions should have exponents of [H+] from 0 to -6.
* Basic solutions will have exponents of [H+] from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on.

 **Example 2**

* What is the [H+] of human saliva if its [OH-] is 4 x 10-8 M? Is human saliva acidic, basic, or neutral?

**Solution:** [H+] = 1.0 x 10-14 / 4 x 10-8 = 2.5 x 10-7 M

* The saliva is pretty \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**II. pH**

* . pH
* relationship between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* pH = -log10[H+]
* Definition of acidic, basic, and neutral solutions based on pH

acidic: if pH is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than 7
basic: if pH is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than 7
neutral: if pH is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to 7

* The [H+] can be calculated from the pH by taking the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the negative pH
* **Example 3:**  calculate the [OH-] of a solution of baking soda with a pH of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* **Solution:**  First calculate the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* if pH is 8.5, then the antilog of -8.5 is 3.2 x 10-9. Thus the [H+] is 3.2 x 10-9 M
* Next calculate the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* 1.0 x 10-14 / 3.2 x 10-9 = 3.1 x 10-6 M
* **Example 4:**  Calculate the pH of a solution of household ammonia whose \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is 7.93 x 10-3 M.
* **Solution:**  This time you first calculate the [H+] from the [OH-]
* 7.93 x 10-3 M OH- = 1.26 x 10-12 M H+
* Then find the pH
* -log[1.26 x 10-12] = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Now you try a few by yourself. You can then check your answers using the Java applet that follows, but remember, you won't learn how to do them if you don't try by yourself first.
* Practice #1. What is the pH of a solution of NaOH that has a [OH-] of 3.5 x 10-3 M?
* Practice #2. The H+ of vinegar that has a pH of 3.2 is what?
* Practice #3. What is the pH of a 0.001 M HCl solution?