Chemistry CP

Name:

Virtual pH Lab

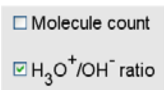
Section:

Introduction:
Previously in this unit, we defined acids as H^+ (or proton) donors. However, in aqueous solution, H^+ ions form complexes with one or more water molecules. These complexes are written as H_3O^+ for simplicity and are given the name "hydronium ion." Often you will see H^+ and H_3O^+ used interchangeably. In this simulation, you will observe ions and changes in hydronium (H_3O^+) and hydroxide (OH^-) concentrations in several common substances.

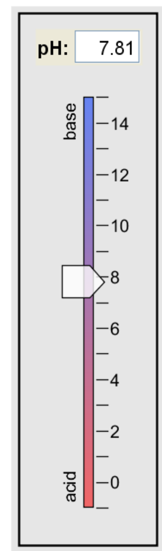
We can calculate a solution's pH using a logarithm, which determines a number's base-ten exponent. The "p" in pH is a negative logarithm (-log). We will investigate this in part II of the lab. In part III, we will determine the number of moles of hydronium present in solution, when concentration and volume is known. These are powerful tools that allow us to measure and determine analytically a solution's acid or basic properties.

Procedure: *PhET Simulations → Play With Sims → Chemistry → pH Scale →* 

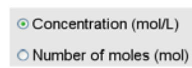
- When running the PhET sims, be sure to click the yellow drop-down bar to allow blocked content.
- Click on ***H_3O^+/OH^- ratio*** box to view the hydronium and hydroxide molecules as model dots in solution.



- Spend a few minutes to become familiar with the simulation and its controls.
- Observe the pH of some common liquids.

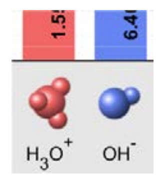


Part I: Changes in Hydronium H_3O^+ and Hydroxide OH^- Concentrations



- Make sure you are viewing concentrations in mol/L.
- Move the pH slider to create custom liquids with varying pH. Observe how increasing the pH on the slider affects the pH and concentrations of hydronium [H_3O^+] and hydroxide [OH^-].

Part I Analysis



As pH increases, the concentration of hydronium [H_3O^+] ______________________.

As pH increases, the concentration of hydroxide [OH^-] ______________________.

Acidic (pH < 7) have a higher concentration of (H_3O^+/ OH^-) and a lower concentration of (H_3O^+/ OH^-). Basic solutions (pH > 7) have a higher concentration of (H_3O^+/ OH^-) and a lower concentration of (H_3O^+/ OH^-).

What is true about the concentration of H_3O^+ and OH^- for neutral solutions (pH = 7)?

____

For any substance, when I multiply [H_3O^+] by [OH^-] I always get ________________.

How does adding more  or less  of a liquid change the [H_3O^+]?

____

The product of [H_3O^+] and [OH^-] is called the autoionization constant of water, K_w

K_w = ____

When the "**p**" or negative logarithm is applied to each term, it can be shown that **pH + pOH = 14**. Memorize this!

Part II: pH – [H_3O^+] Calculations

- Choose several of the sample liquids and observe their H_3O^+ concentrations
- Find the "pH" of a few sample liquids by taking the negative logarithm of the liquids H_3O^+ concentration
  - (Use the log button on your calculator
  - Do you need to hit the log button first, or do you need to enter the concentration first?

- Complete the table below

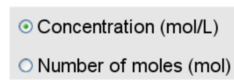
Sample Liquid Used	$[H_3O^+]$ Concentration [M]	pH (-log $[H_3O^+]$)

Part II Analysis

How do your calculations for pH match the pH identified in the simulation? ________________________________

How does the pH change as $[H_3O^+]$ increases? ____

Part III: Volume and Molarity



- Use  and  increase or decrease the volume of your liquids.
- You can toggle between concentration and number of moles with the button above.
- Observe the effect of changing volumes on the number of moles of H_3O^+ and OH^-.
- Choose several of the sample liquids and observe their H_3O^+ concentrations
- Find the number of moles of a few sample liquids by multiplying $[H_3O^+]$ by volume
- Complete the table below. Do the calculation for moles and check your work in the simulation by selecting "Number of moles (mol)"

Sample Liquid Used	$[H_3O^+]$ Concentration [M]	Volume Used (L)	Number of Moles (mol)

Part III Analysis

The **unit** that is the product of concentration (mol/L) and volume (L) is _______________________.

How do your calculations for moles match the moles in the simulation? ________________________________

Concentration and ion moles are equal only when volume is _______________________.

Conclusion Questions *(GRADED, 1 pt Each)*

Math Review

1. Of 1.0×10^{-6} and 1.0×10^{-4}, the larger number is 1. _________________________.
2. The logarithm of 100 (aka 10^2) is 2. _________________________.
3. The logarithm of .001 (aka 10^{-3}) is 3. _________________________.
4. The logarithm of 2.5×10^{-3} is 4. _________________________.
5. The solution to $1 \times 10^{-14} / 3.6 \times 10^{-8}$ is 5. _________________________.
6. The product of $[OH^-]$ and $[H_3O^+]$ for any solution is always 6. _____________________M_.