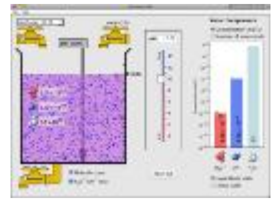
Name:____________________

Acid and Base pH PhET Lab (rvsd 5/2011)

Investigating pH and acid and base concentration of common liquids



Introduction:

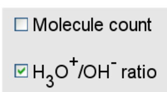
In this simulation, you will observe ions and changes in hydronium (H_3O^+) and hydroxide (OH^-) concentrations in several common substances. Remember, the autoionization constant of water K_w is ________________ and is equal to the product of $[H_3O^+]$ and $[OH^-]$. When the "**p**" or negative logarithm is applied to each term, the relationship exists that **pH + pOH = 14**.

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.

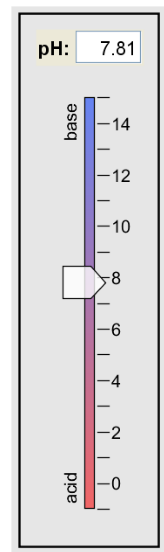
In part III, we will determine the number of moles of hydronium present in solution, when concentration and volume is known. These are powerful tools that allow us to measure and determine analytically a solution's acid or basic properties.

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

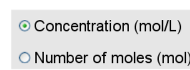
- When running the PhET sims, be sure to click the yellow drop-down bar to allow blocked content.
- Click on ***H_3O^+/OH^- ratio*** box to view the hydronium and hydroxide molecules as model dots in solution.



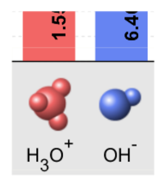
- Spend a few minutes to become familiar with the simulation and its controls.
- Observe the pH of some common liquids.



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 $[OH^-]$ ______________________.

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

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

____

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
- Complete the table below

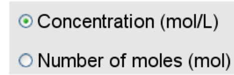
Sample Liquid Used	$[H_3O^+]$ Concentration [M]	pH (-log $[H_3O^+]$)

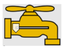
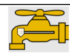
Part II Analysis

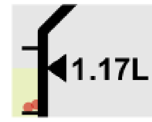
How do your calculations for pH match the pH identified in the simulation? ______________________________

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, ½ 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. ________________________.

Part I

6. Acids have _____________ pH while bases have ______________ pH.
7. pH is a logarithmic scale. This means that for a change of pH 3 to pH 2, the hydronium ion concentration $[H_3O^+]$ changes by 7. ________________________.
8. Acids have a $[H_3O^+]$ that is *greater than / less than* (circle) 8. _____________________M_.
9. Bases have a $[H_3O^+]$ that is *greater than / less than* (circle) 9. _____________________M_.
10. The product of $[OH^-]$ and $[H_3O^+]$ for any solution is always 10. ____________________M_.
11. In neutral water both $[H_3O^+]$ and $[OH^-]$ equal 11. ____________________M_.
12. When $[H_3O^+] = 2.3 \times 10^{-4}$, the $[OH^-]$ must equal 12. ____________________M_.
13. When $[OH^-] = 4.5 \times 10^{-9}$, the $[H_3O^+]$ must equal 13. ____________________M_.

Part II

14. Soda pop has a pH of 2.5. What is soda's hydronium concentration $[H_3O^+]$? 14. ____________________M_.
15. What is soda's $[OH^-]$? 15. ____________________M_.
16. An unknown solution is found to have a $[H_3O^+]$ of 3.8×10^{-5}. What is its pH? 16.______________________.
17. What is the above solution's $[OH^-]$? 17. ____________________M_.

Part III

18. How many moles of hydronium are present in 0.85 L of a 5.25×10^{-5} M solution? __________________mol_.
19. How much (volume) of .15 M NaOH would be required to have .60 moles of OH^-? __________________L_.
20. If 250 mL of an unknown acid was found to contain .45 moles of H^+ ions, what concentration was the unknown acid? 20. ____________________M_.
21. What volume of coffee (pH = 5.0) would be required to have .25 moles of H_3O^+ ions? (hint: two step) 21. ____________________L_.