Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period \_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_

**Activity: Exploring pH relationships**

**Instructions:**

Go to the following simulation: <https://phet.colorado.edu/sims/html/ph-scale/latest/ph-scale_en.html>

**Part A: Relationship between pH, [H+], [OH-]**

1. Click on **“My Solution”** button at the bottom center of your screen. This part of simulation lets you change the pH of the solution to see how [H+] and [OH-] change. Adjust the pH to the following and record the corresponding [H+] and [OH-]. For the second to last column, multiply [H+] and [OH-] together.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| pH | [H+] | [OH-] | [H+] x [OH-] | Acidic? Basic? Neutral? |
| 1.00 |  |  |  |  |
| 4.00 |  |  |  |  |
| 7.00 |  |  |  |  |
| 10.00 |  |  |  |  |
| 13.00 |  |  |  |  |

1. How did you know if a solution was acidic? Name two ways to determine if a solution is acidic.
2. How did you know if a solution was basic? Name two ways to determine if a solution is basic.
3. What is the relationship between [H+] and pH?
4. What is the relationship between [OH-] and pH?
5. Look at the exponents on the concentrations for [H+] and compare it the pH. What is the pattern?
6. Look at the exponents on [H+] and [OH-] in the table above. Compare them. What do you notice?
7. Look at the second to last column of your table above, where you multiplied [H+] and [OH-]. What did you notice about your answers? What does this remind you of?

*Teacher check. Show you are on the right track and get your teacher’s initials. \_\_\_\_\_\_\_\_\_\_\_\_\_\_*

1. Now use the simulation to fill in the table below and answer the questions. For the second to last column, multiply [H+] and [OH-] together.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| pH | [H+] | [OH-] | [H+] x [OH-] | Acidic, Basic, or Neutral |
| 2.99 |  |  |  |  |
| 4.95 |  |  |  |  |
| 8.05 |  |  |  |  |
| 10.23 |  |  |  |  |

1. Is the relationship between [H+] and pH still the same as the previous table?
2. Is the product of [H+] and [OH-] still the same as the previous table?
3. How does this table and the previous one differ?

**Part B: The Power of Hydrogen – Read carefully**

The term pH stands for the power (as in exponent) of hydrogen. Exponential functions in math are related to logarithmic functions. Therefore, the relationship between {H+] and pH is a logarithmic function mathematically speaking.

If you are given [H+], you can calculate pH using: **pH = - log10[H+]** (note the negative sign)

*Example:*

If you were give the [H+] = 1.0 x 10-2 M, the pH would the negative of that exponent which would be “2”.

But the [H+] isn’t always so perfect that you wouldn’t need a calculator. Locate the log function on your calculator and try the following.

* Determine the pH of a solution whose [H+] is 5.00 x 10-12 M. Show your work.
* Use the simulation to check your answer by dragging the [H+] slider to this concentration and seeing what the pH is.

If you are given pH, you can calculate [H+] using: **[H+] = 10-pH** (note the negative sign)

*Example*: If you were give the pH of 3.00. The [H+] would be 10-3 which we would write as 1 x 10-3 M.

But pH is not always a nice number like that you wouldn’t ever need a calculator. Locate the 10x button on your calculator and try the following.

* Determine the [H+] concentration of a solution with a pH of 3.45. You must write this answer in proper scientific notation where the exponent is a whole number.
* Use the simulation to check your answer by setting the pH and then noting the [H+]

**Part C: pOH – The Power of Hydroxide**

We can also calculate pOH in a similar way. Furthermore, the sum of pH and pOH will always equal 14 because [H+] x [OH-] always equals 1.0 x 10-14 (the negative log of this number is 14).

pOH = - log [OH-] [OH-] = 10-pOH pH + pOH = 14**Part D: Putting it all together**

**pH = - log10[H+] [H+] = 10-pH pOH = - log [OH-] [OH-] = 10-pOH pH + pOH = 14**

Fill in the blanks in the table below using what you have learning about the relationships [H+], [OH-], pH, and pOH.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| pH | [H+] | [OH-] | pOH | Acidic/Basic/Neutral |
| 5.00 |  |  |  |  |
|  |  |  | 5.00 |  |
|  | 1.0 x 10-6 |  |  |  |
|  |  | 1.0 x 10-3 |  |  |
| 2.15 |  |  |  |  |
|  |  |  | 1.69 |  |
|  | 4.8 x 10-9 |  |  |  |
|  |  | 5.2 x 10-10 |  |  |
|  |  |  |  | Neutral |