**Introduction:** When you test your pool’s pH, what are the little vials or paper strips telling you? When you hear an acid called “strong” or “weak,” what do those terms refer to? In aqueous solutions, compounds can exist as molecules or charged ions. When an acid or base exists in a solution and is 100% ionized (acids) or 100% dissociated, we refer to that acid or base as *strong*. A weak acid or base will donate ions to the solution, but will remain primarily as molecules.

### Prelab:

### On the pH scale below, label the areas that are acidic, basic, and neutral. Then, draw the appropriate amount of H+1 and OH-1 ions in each of those areas. 0 -------------------------------------------------------------- 7 ------------------------------------------------------------ 14

### *Water molecules are not shown.* Each beaker contains the same volume of solution;

### Key: = HA (unreacted acid) = A-1 = H+1

**Beaker** **A**

**Beake**r **B**

**Beaker** **C**

**Beaker** **D**

Which beaker would have the lowest pH? A B C D Explain your reasoning:

1. You have two beakers. One beaker contains 100 mL of NaOH (a strong base); the other contains 100 mL of aqueous Na3PO4 (a weak base). You test the pH of each solution. Which of the following statements is true?

100 mL 100 mL

NaOH(aq) Na3PO4(aq)

1. The Na3PO4 has a higher pH because it has more sodium ions than NaOH.
2. It is possible for the solutions in each beaker to have the same pH.
3. If the pH of the NaOH solution is 12.00, the pH of the Na3PO4 solution has to be greater than 12.00.
4. If the pH of the NaOH solution is 12.00, the pH of the Na3PO4 solution has to be less than 12.00.

Explain your reasoning:

**Instructions:**

1. **Go to http://www.phet.colorado.edu and click Play with Simulations**
2. **On the left-hand menu, click “By Device” then “Chromebook”**
3. **Click the 1st simulation: Acid-Base Solutions**



**Notation for this Lab:**

**Acids** are abbreviated **HA**, with the H representing the proton (**H+**) the acid donates to the solution. The **A** is referred to as the acidic anion (**A-**) that is left in solution when the proton is donated. Ionization Ex: **HA 🡪 H+ + A-

Strong Bases** are abbreviated **MOH,** with the **OH** representing the hydroxide ion (**OH-**) the base donates to the solution. The **M** is the metal cation (**M+**) that is left in solution when the hydroxide is donated. Dissociation Ex: **MOH 🡪 M+ + OH-**

**Autoionization of Water:**

Even without any acid or base added, a very small number of water molecules will form protons (H+) and hydroxide ions (OH-) because water is *amphoteric*, meaning it can act as an acid and a base. The protons will join with whole water molecules and form hydronium ions (H3O+).



**Procedure Part 1--Introduction:**

***The concentration of the acids and bases used in the Introduction are 0.010 M (1 x 10-2 M).***

1. Begin with a strong acid and lower the pH probe into the beaker. What is the pH of the solution? Record this in the data table below.
2. Test this strong acid with both pH paper and the conductivity probe by changing tools. What color does the indicator paper become? Is this strong acid an electrolyte? Does current travel through the solution? Record your observations in the data table below.
3. Repeat steps 1-2 with the weak acid, strong base, the weak base, and water.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Strong Acid | Weak Acid | Strong Base | Weak Base | Water |
| pH meter read (value) |  |  |  |  |  |
| pH paper (color) |  |  |  |  |  |
| Conductivity (bright/dim/none) |  |  |  |  |  |
| Exists as Mostly (ions/molecules) |  |  |  |  |  |

**Procedure Part 2—My Solution:**

This simulation allows you to change the concentration of a strong and weak acid and base.

Complete the table below for some strong acids and bases and weak acids and bases by adjusting the concentration. Show your calculations for each substance in the space below the table.

**Strong Acids**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Strength | Initial Acid Concentration (mol/L) | [HA] (mol/L) | pH | [H+1] (mol/L) | [OH=1] (mol/L) | pOH |
|  | .010 M |  |  |  |  |  |
|  | .050 M |  |  |  |  |  |
|  | .100 M |  |  |  |  |  |
|  | 1.00 M |  |  |  |  |  |

**Calculations for Strong Acids:**

**Strong Bases**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Strength | Initial Base Concentration (mol/L) | [MOH] (mol/L) | pH | [H+1] (mol/L) | [OH=1] (mol/L) | pOH |
|  | .010 M |  |  |  |  |  |
|  | .050 M |  |  |  |  |  |
|  | .100 M |  |  |  |  |  |
|  | 1.00 M |  |  |  |  |  |

**Calculations for Strong Bases:**

**Conclusion Questions:**

1. A strong acid *is very concentrated / exists primarily as ions*. (circle)
2. A weak base is a *nonelectrolyte / weak electrolyte / strong electrolyte*. (circle)
3. A strong base is a *nonelectrolyte / weak electrolyte / strong electrolyte*. (circle)
4. At the same concentration (Molarity) a strong acid will have a *higher / lower / the same* pH as a weak acid. (circle)
5. As concentration of a weak acid increases, the pH *increases / decreases / remains constant*. (circle)
6. As concentration of a weak base increases, the pH *increases / decreases / remains constant*. (circle)
7. As the concentration of a weak acid increases, the **number of ions** *increases / decreases / remains constant*. (circle)
8. As the concentration of a weak acid increases, **conductivity** *increases / decreases / remains constant*. (circle)
9. As the strength of a weak acid increases, the **proportion** **of ions to molecules** *increases / decreases*. (circle)
10. As the strength of a weak acid increases, the **conductivity** *increases / decreases / remains constant*. (circle)
11. What are the pH values of a strong base with a concentration of **0.10** and a strong acid with a concentration of **0.10**?

Strong Base, 0.10 M :\_\_\_\_\_\_\_\_\_\_\_\_ Strong Acid, 0.10 M :\_\_\_\_\_\_\_\_\_\_\_\_