This is our OLD pH Worksheet

Introduction:

The purpose of this exercise is to examine logarithms.

Objectives:

- Understand the mathematical meaning of logarithm.
- Be familiar with logs in base 10.
- Understand the significance of logarithm in science.
- Calculate pH and understand different pH values.
- Use semi-log graph paper to generate a standard curve.

pH:

The pH scale is a measurement scale used to quantify the concentration of hydrogen ions, H+, in a solution. The scale runs from 0-14, "0" being the most acidic, "7" neutral, and "14" being the most alkaline or basic. It is a logarithmic scale, based on powers of 10, so that one pH unit change equals a 10 fold change in H+ ion concentration! The more H+ in the solution, the lower the pH. Human blood pH is about 7.35, being slightly alkaline. Metabolic disturbances in the body can create conditions where H+ is produced in excess, lowering the pH of the blood. If pH goes outside of the normal range significantly, enzymes, hormones, and other molecules can become dysfunctional. What is critical to comprehend is that small changes in pH can signify large changes in H+ concentration; this is best understood by working problems involving pH.

Solving for pH

Given the [H+], or concentration of hydrogen ions in a solution (expressed as moles per liter or Molarity (M)), pH can be determined as

pH = - log [H+] = log 1/[H+]

Example:

What is the pH of a solution for which the hydrogen ions are present at a concentration of 0.000005 moles per liter (Molar, M)?

Solution:

pH = - log [H+]
= - log (0.000005)
= - (-5.30) = 5.3

Solving for [H+]:

Given the pH for a solution, the concentration of hydrogen ions, H+, in moles per liter or solution molarity, M, can be determined as

$$[H^+] = 10^{(-pH)}$$

Example:

What is the hydrogen ion concentration of a solution of pH 7.10?

Solution:

$[H^+] = 10^{(-pH)}$
$= 10^{(-7.1)}$
$= 0.000000079432 = 7.9432 \times 10^{-8}$ M

Problems:

1. What is the hydrogen ion concentration of a solution of pH 7.4?
2. What is the hydrogen ion concentration of a solution of pH 7.2?
3. Compared to a basic solution at pH 9, the same volume of an acidic solution at pH 4 has ____________________X more hydrogen ions (H+).

Solving for pH changes:

Given two pH measurement, the change in [H+] can be determined by first determining the [H+] for each separate pH, then calculating the percent change in [H+] from one pH to the other pH.

Example:

What is the percent change in [H+] if the pH of a solution, such as blood, changes from pH 7.35 to pH 7.15 (a 2% drop in pH)?

Solution:

At pH 7.35, [H+] = $10^{-7.35}$ = 0.000000045 or 4.5 X 10^{-8} M

At pH 7.15, [H+] = $10^{-7.15}$ = 0.000000071 or 7.1 X 10^{-8} M

The percent change in [H+] can be calculated as

% change = 100(new-original)/original

= 100(0.000000071- 0.000000045)/ 0.000000045
= 100 (0.58)
= 58 %

58% change in [H+] for a 2% pH change. BIG DIFFERENCE!

Problems:

1. What is the percent change in [H+] if the pH of a solution, such as blood, changes from pH 7.4 to pH 7.2?
2. What is the percent change in [H+] if the pH of a solution, such as blood changes from pH 7.35 to pH 7.1?