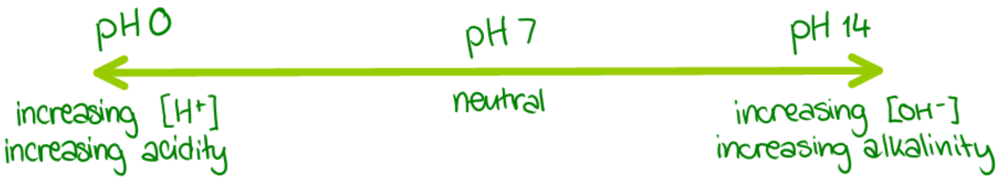
8.4 – The pH Scale

8.4.1 - Distinguish between aqueous solutions that are acidic, neutral or alkaline using the pH scale



The pH scale is used to give a scale of how acidic or alkaline a solution is based on the concentration of H^+ ions in solution. Any solution with a $pH < 7$ is acidic. A solution with a pH of 7 is neutral, and a solution with a $pH < 7$ is alkaline.

These concentrations will usually have negative exponents, such as 6.82 x 10^{-9} mol dm^{-3}. Using this as the comparison point would prove impractical, so the concentration is converted into another value according the equation:

$$pH = -\log_{10}[H^+]$$

This gives a positive value such as 9.2 or 3.7, which can be more easily used to compare solutions. The equation can be rearranged to give:

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

8.4.2 - Identify which of two or more aqueous solutions is more acidic or alkaline using pH values

When two solutions are compared, the one with the largest pH value is more alkaline, and the one with the smallest pH value is the most acidic. In order to determine pH, indicator substances or pH meters can be used.

Universal Indicator

If the indicator paper is used, the pH is determined based on the colour the paper turns when placed in the solution. Different indicators can be used to accurately determine the pH, although the problem arises that people interpret colours differently.

Alternatively, indicator solution can be dropped into the solution, allowing the entire solution to change colour. The pH is likewise determined by the new colour of the solution.

pH Meter

This reads the concentration of H^+ ions through an electrode, giving the pH with an accuracy of a few decimal points. This method is more objective than using indicator solutions and is more accurate.

8.4.3 - State that each change of one pH unit represents a 10-fold change in the hydrogen ion concentration

The concentration of H^+ ions in a solution and the pH of the solution have an inverse relationship. A change of one pH unit equates to a ten-fold change in $[H^+]$ because the scale is logarithmic. If the pH increases, the $[H^+]$ decreases, and vice versa.

8.4.4 - Deduce changes in $[H^+_{(aq)}]$ when the pH of a solution changes by more than one pH unit

If the pH increases, the $[H^+]$ decreases, and vice versa.

The pH of a solution changes from 2 to 6, deduce how the $[H^+]$ changes

pH = 2

$\therefore [H^+] = 10^{-2}$ mol dm^{-3}

pH = 6

$\therefore [H^+] = 10^{-6}$ mol dm^{-3}

so, the pH has changed by 10^{-4}, a decrease of 10000