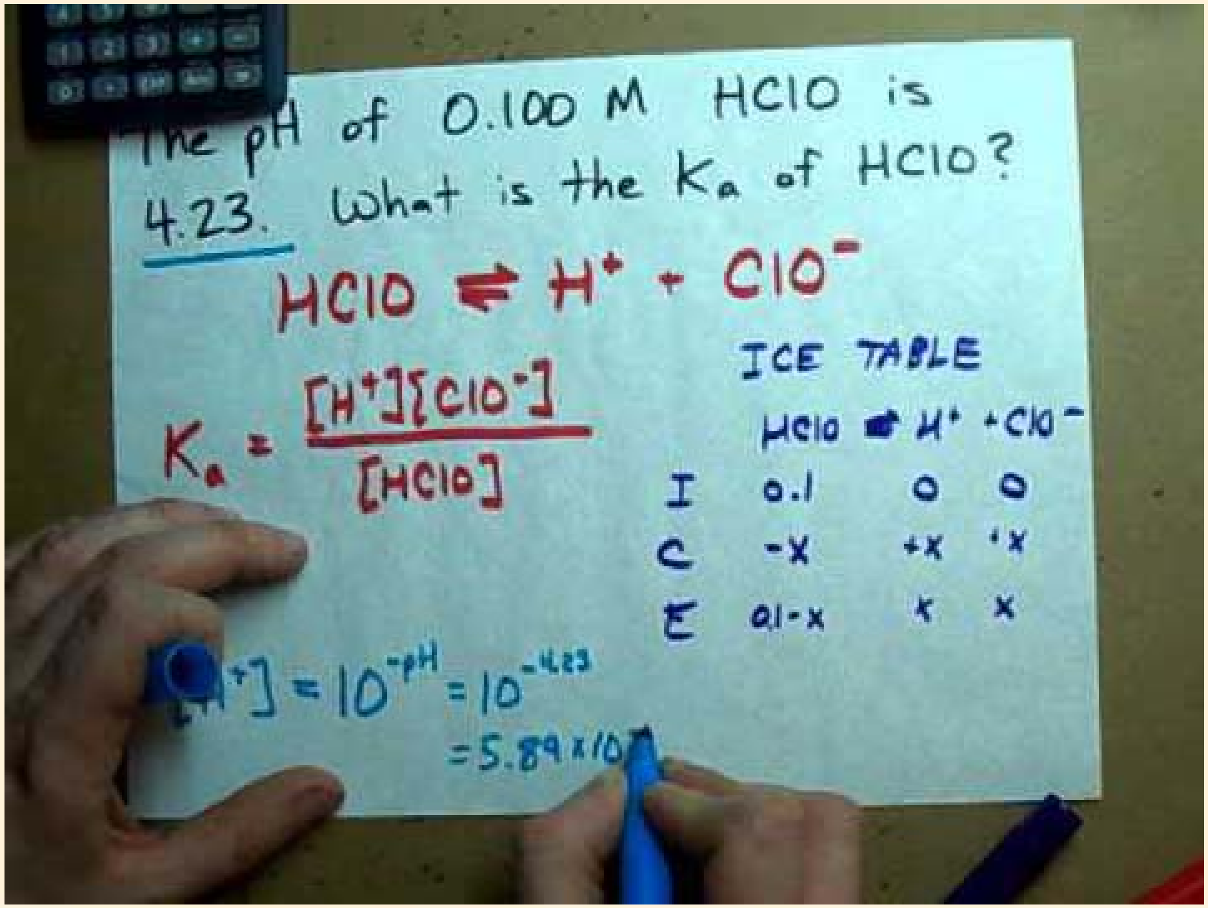
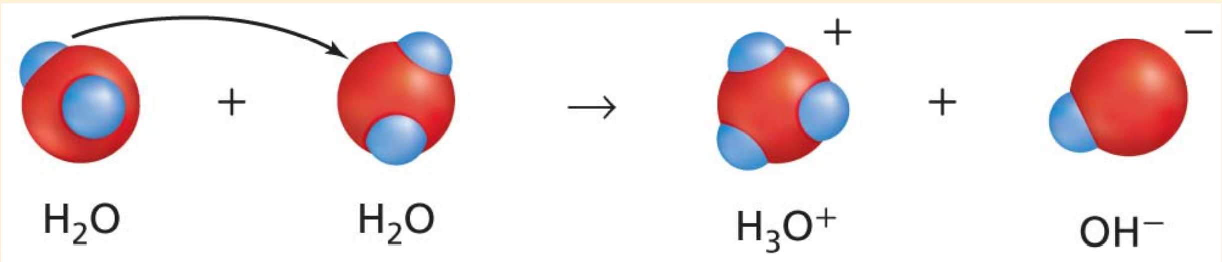
Notes 13 - Calculating pH



Ion Product Constant for Water

- Pure water contains equal concentrations of H^+ and OH^- ions.
- The ion product constant of water,
  $K_w = [H^+][OH^-]$.
- The **ion product constant for water** is the value of the equilibrium constant expression for the self-ionization of water.



Ion Product Constant for Water (cont.)

- With pure water at 298 K, both [H^+] and [OH^-] are equal to $1.0 \times 10^{-7} M$.

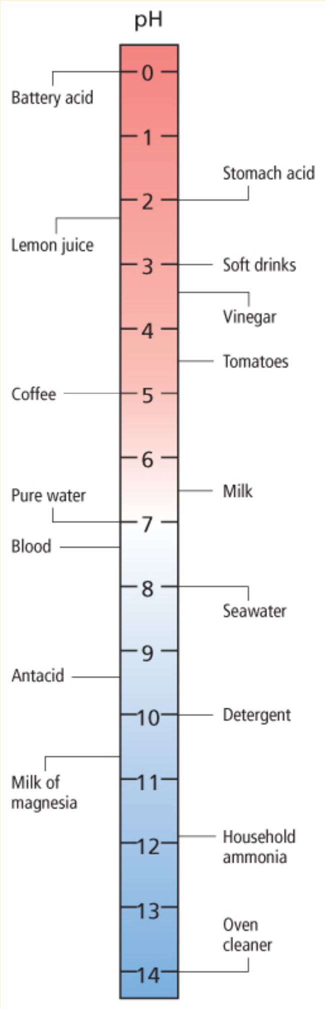
$$K_w \text{ at } 298 \text{ K} = 1.0 \times 10^{-14}$$

- K_w and LeChâtelier's Principle proves [H^+] × [OH^-] must equal 1.0×10^{-14} at 298 K, and as [H^+] goes up, [OH^-] must go down.

pH and pOH

- Concentrations of H^+ ions are often small numbers expressed in scientific notation.
- pH is the negative logarithm of the hydrogen ion concentration of a solution.

$$pH = -\log [H^+]$$

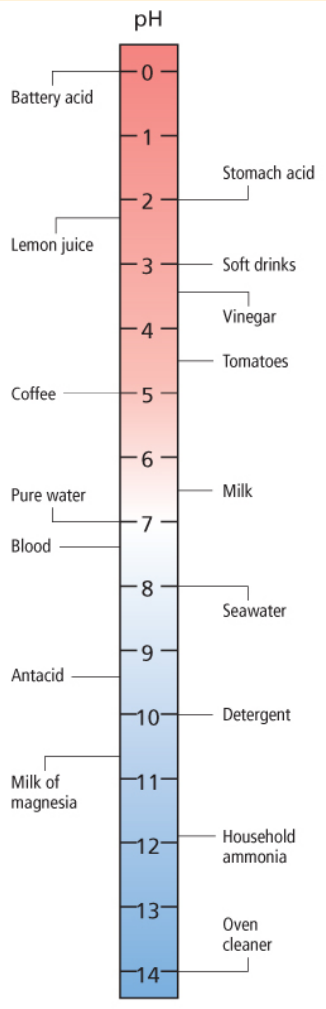


Hydrogen Ions and pH

Practice Problem

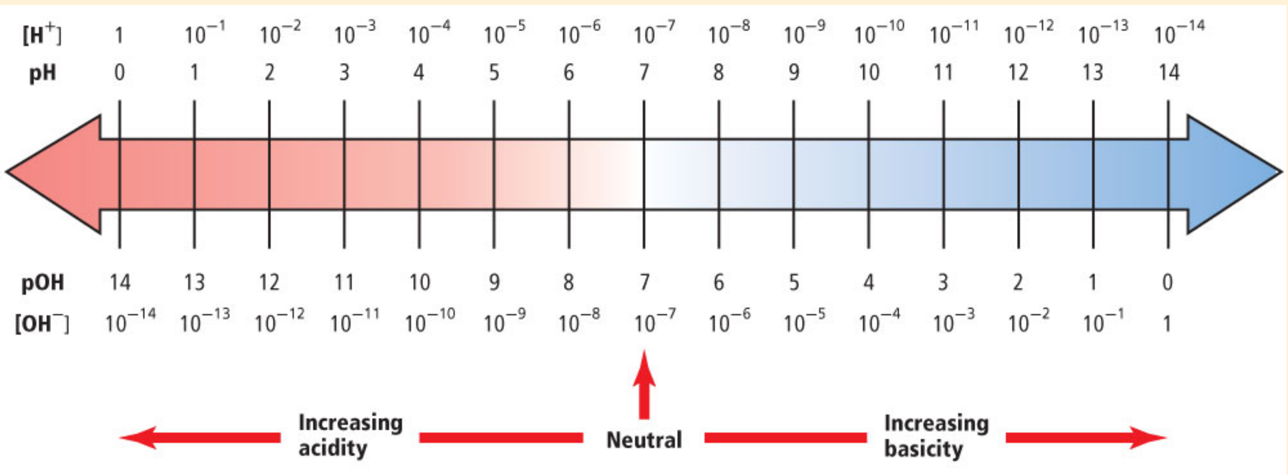
- 1) Determine the pH of a solution with $[H_3O+] = 0.500$ M

- $pH = -\log [H^+]$
- $pH = -\log [0.500]$
- $pH = 0.301$



pH and pOH (cont.)

- **pOH** of a solution is the negative logarithm of the hydroxide ion concentration.
- $pOH = -\log [OH^-]$
- The sum of pH and pOH equals 14.



$[H^+]$	1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}	10^{-11}	10^{-12}	10^{-13}	10^{-14}
pH	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
pOH	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
$[OH^-]$	10^{-14}	10^{-13}	10^{-12}	10^{-11}	10^{-10}	10^{-9}	10^{-8}	10^{-7}	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	1

Practice Problem

- What is the pH of a solution whose pOH is 11.09?
- pH + pOH = 14
- pH + 11.09 = 14
- pH = 14 - 11.09
- pH = 2.91