pH scale

power of Hydrogen

pH

pH

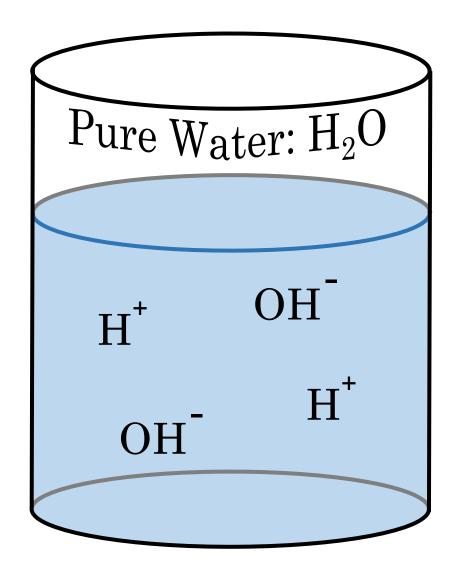
pH

Scale generally runs from 0 - 14

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In pure water a few of the water, H_2O , molecules will split up into hydrogen, H^+ , and hydroxide, OH^- , ions.

$$H_2O \rightarrow H^+ + OH^-$$

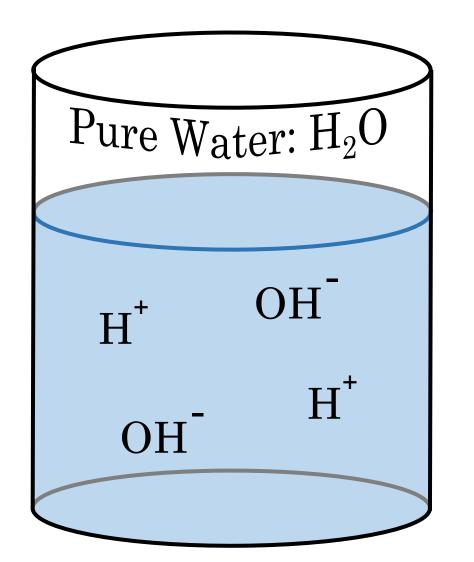


In pure water the number of \mathbf{H}^{\dagger} and $\mathbf{OH}^{\overline{}}$ ions are equal.

 H^{\dagger} and OH^{-} are balanced.

This corresponds to a pH of 7.

pH7 = Neutral



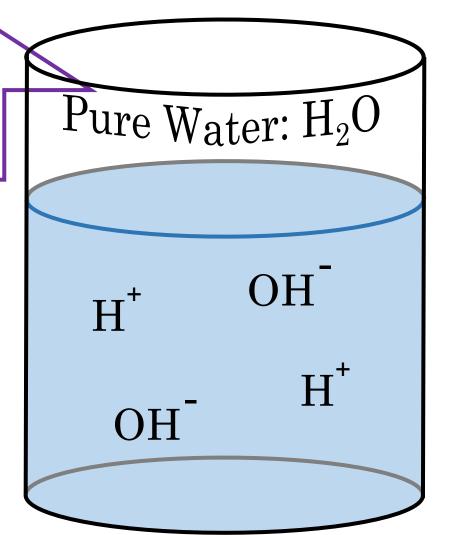
In pure water the numb

 $\overrightarrow{H}^{\dagger}$ and $\overrightarrow{OH}^{}$ ions are equivalent Neutral

 H^{\dagger} and OH^{-} are balanced.

This corresponds to a pH of 7.

pH7 = Neutral



If an acid is added to the water, the quantity of \boldsymbol{H}^{\dagger} will increase.

Acids release H^{\dagger}

 $\begin{array}{c} \text{more} \ H^{\intercal} \\ \text{pH value drops} \end{array}$



If an acid is added to the water, the quantity of H^{+} will increase.

Acids release H^{\dagger}

more H⁺ pH value drops

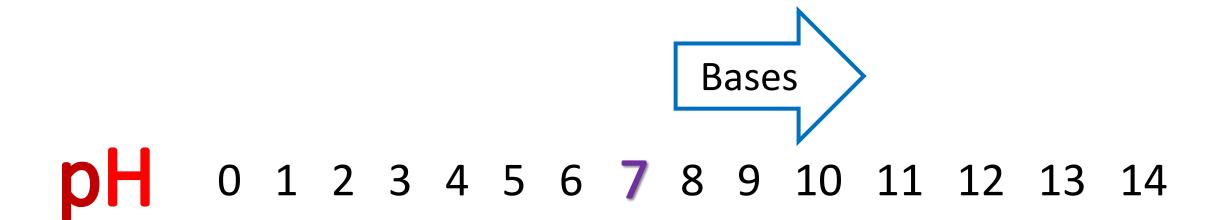
Acids O 1 2 3 4 5 6 7 8 9 10 11 12 13 14

- The stronger the acid, the lower the pH.
 - An acid with pH = 5 is 10X stronger than pH = 6
 - An acid with pH = 3 is 10X stronger than pH = 4
 - An acid with pH = 2 is 100X stronger than pH = 4

If a base is added to the water, the quantity of \mathbf{OH}^{T} will increase.

Bases release OH

 $\begin{array}{c} \text{less } H^{\, \text{t}} \\ \text{pH value rises} \end{array}$



If a base is added to the water, the quantity of \mathbf{OH}^{T} will increase.

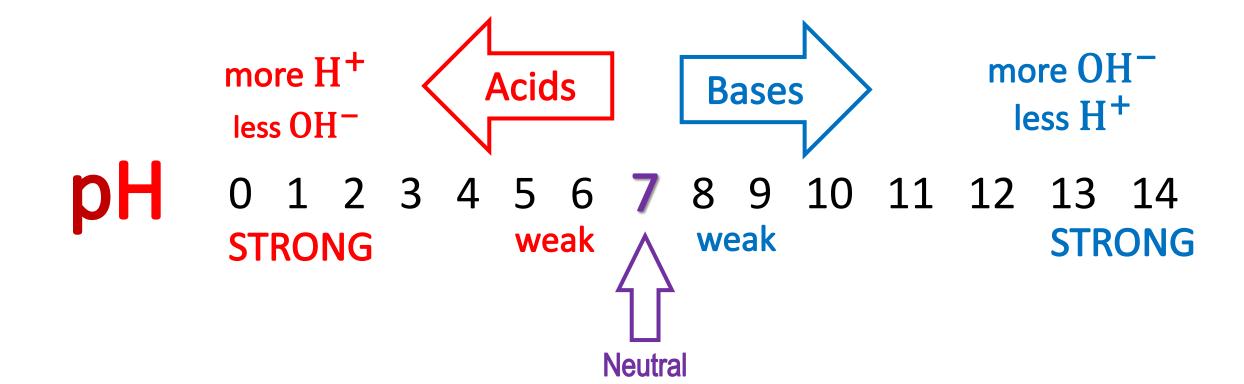
Bases release OH

less H
pH value rises

The stronger the base, the higher the pH.

Dissolving a salt in the water (normally) does not affect the balance between \mathbf{H}^+ and \mathbf{OH}^- ions.

Saline (salt) solutions are usually neutral: pH = 7



Mathematics behind the pH scale

Exponents and Logarithms

$$10^3 = 1000$$

$$10^{-3} = 0.001$$

$$10^{-5} = 0.00001$$

$$10^{2.5} \approx 316.2278$$

$$10^? = 1000000$$

$$? = \log(1\,000\,000)$$

$$? = 6$$

Mathematics behind the pH scale

Exponents and Logarithms

$$10^3 = 1000$$

$$10^{-3} = 0.001$$

$$10^{-5} = 0.00001$$

$$10^{2.5} \approx 316.2278$$

$$10^? = 0.0000001$$

$$? = \log(0.000\ 000\ 1)$$

$$? = -7$$

Mathematics behind the pH scale

Exponents and Logarithms

$$10^3 = 1000$$

$$10^{-3} = 0.001$$

$$10^{-5} = 0.00001$$

$$10^{2.5} \approx 316.2278$$

$$10^? = 5000$$

$$? = \log(5000)$$

$$? \approx 3.699$$

Mathematics behind the pH scale

Concentration of hydrogen ions measured in moles per litre (mol/L) (a.k.a. molar concentration)

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

Pure water (Neutral):

$$[H^+] = 1 \times 10^{-7} \text{ mol/L}$$

(0.0000001 mol/L)

$$pH = 7$$

 $10 \times \text{more H}^+$:

$$[H^+] = 1 \times 10^{-6} \text{ mol/L}$$

(0.000001 mol/L)

$$pH = 6$$

A really small amount of H⁺:

$$[H^+] = 1 \times 10^{-13} \text{ mol/L}$$

(0.000000000001 mol/L)

$$pH = 13$$

pH of Common Substances

ACIDIC									NEUTI	RAL				ALKALINE OR BASIC					
0	1	2	3	3	4	5	5	6	7	Ì	8		9	10	11	12	2	13	14
Battery Acid	Stomach Acid (Hydrochloric)	Lemon Juice, Vinegar	Coke and Pepsi Grapefruit and Orange Juice	Apples, Dr. Pepper Soda	Tomato Juice, Beer	Acid Rain, 7-UP Soda Black Coffee, Pepto Bismol	Healthy Skin, Hair and Nails	Urine, Saliva, Milk	"Pure" Water, Blood	Shampoos (7.0 to 10.0)	Baking Soda, Seawater, Eggs	Perm Solutions (8.5 to 9.5)	Toothpaste, Hand Soap	Milk of Magnesia, Mild Detergent	Household Ammonia and Cleaners	Soapy Water Hair Straighteners (11.5 to 14.0)		Bleach, Oven Cleaner	Liquid Drain Cleaner, Caustic Soda