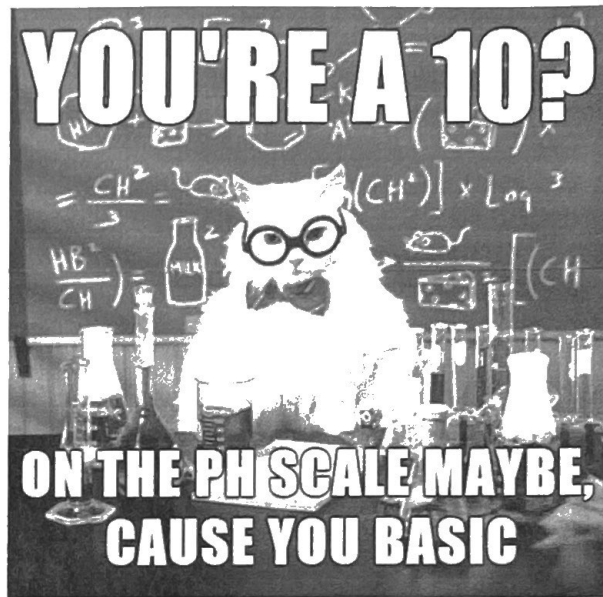


The pH Scale

Acidic, Basic, and Neutral Solutions

- Acid Solutions: (acid in water)
 - $[H_3O^+] \text{ or } [H^+] > [OH^-]$
- Basic Solutions: (base on water)
 - $[H_3O^+] \text{ or } [H^+] < [OH^-]$
- Neutral Solutions: (just water)
 - $[H_3O^+] \text{ or } [H^+] = [OH^-]$



pH: The Power of Hydronium $[H_3O^+]$

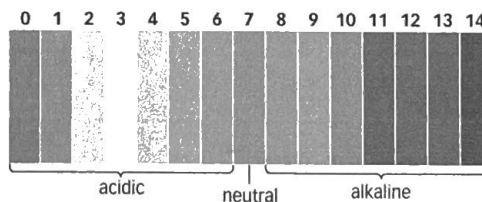
- The pH scale is used to measure the hydrogen ion concentration $[H^+]$
- $pH = -\log [H^+]$
- Acidic solutions: $pH < 7$ (low pH)
- Neutral solutions: $pH = 7$
- Basic solutions: $pH > 7$ (high pH)

Measuring pH

- If $[H^+] = 1.0 \times 10^{-4}$, the pH is 4
- The exponent gives you the pH
- At pH 4, $[H^+] = 1 \times 10^{-4} M = 0.0001 M$
- A solution with a pH of 3, $[H^+] = 1 \times 10^{-3} M = 0.001 M$
- When the pH decrease by 1 unit, the concentration of hydrogen ions increase by a factor of 10 (10 times greater)

The pH Scale

- Measures how acidic or basic a substance is
- Ranges from 0-14
 - $pH = 7$ Neutral $[H_3O^+] \text{ or } [H^+] = [OH^-]$
- $pH < 7$ (Below 7)
 - Acidic $- [H_3O^+] \text{ or } [H^+] > [OH^-]$
- $pH > 7$ (Above 7)
 - Basic $- [H_3O^+] \text{ or } [H^+] < [OH^-]$
 - Basic = alkaline
- The pH system is logarithmic, so...



- Each whole pH value below 7 is ten times more acidic than the next highest number
 - Ex. A solution with a pH 4 is 10 times more acidic than a pH 5 solution
 - Ex. A solution with a pH 4 is 100 times more acidic than a pH 6 solution
- Each whole pH value above 7 is ten times more basic than the previous smaller number
 - Ex. A solution with a pH 10 is 10 times more basic than a pH 9 solution
 - Ex. A solution with a pH 10 is 100 times more basic than a pH 8 solution

Calculating pOH

- pOH measures the concentration of OH^- ions
- $pOH = -\log [OH^-]$ $pH + pOH = 14$
- $pH = 14 - pOH$
- $pOH = 14 - pH$

Acids

- low pH
- high pOH

Bases

- high pH
- low pOH

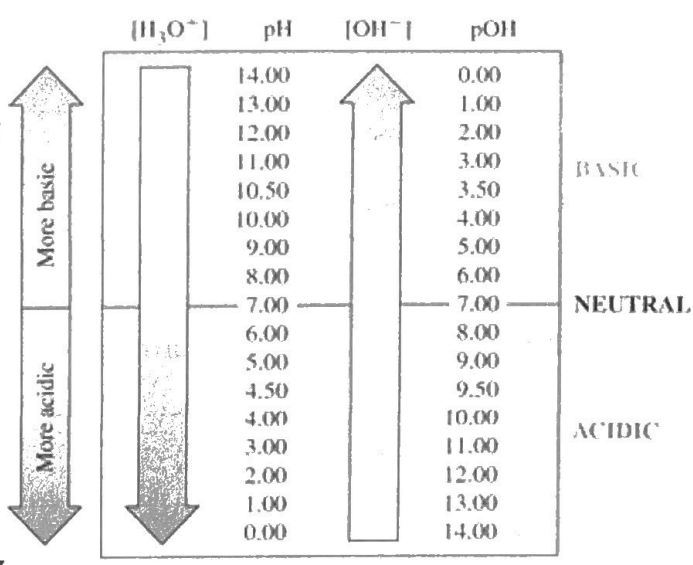
Neutral

- $pH = pOH$

$pH = \text{potential } H^+$
 $pOH = \text{potential } OH^-$

Calculating pOH: Example

- If the pH of $H_2SO_4 = 3.78$, what is the pOH?
 Based on the pH scale, is this an acid or a base? Why?
 $pH + pOH = 14$
 $3.78 + pOH = 14$
 $-3.78 \quad -3.78$
 $pOH = 10.22$
 Acid b/c $pH < 7$
- What is the pOH of HBr if the pH is 1.52? Based on the pH scale, is this an acid or a base? Why?
 $pH + pOH = 14$
 $1.52 + pOH = 14$
 $-1.52 \quad -1.52$
 $pOH = 12.48$
 Acid b/c $pH < 7$
- What is the pH of HCl if the pOH is 10.5? Based on the pH scale is this an acid or a base? Why?
 $pH + pOH = 14$
 $pH + 10.5 = 14$
 $-10.5 \quad -10.5$
 $pH = 3.5$
 Acid b/c $pH < 7$



pH Scale Checkpoint Questions

- An acidic solution can have a pH of _____.
 a. 7 (Neutral)
 b. 10 (base)
 c. 3 (Acid)
 d. 14 (base)
- An aqueous solution that has a hydrogen ion concentration of 1.0×10^{-8} moles per liter (M) has a pH of _____.
 a. 6, which is basic
 b. 6, which is acidic
 Look @ exponent - $pH = 8$
 c. 8 which is basic
 d. 8 which is acidic
- What is the pH of 0.00001 molar HCl solution?
 a. 1
 b. 9
 1×10^{-5} or $-\log(0.00001) = 5$
 c. 5
 d. 4
- A basic solution can have a pH of _____.
 a. 4
 b. 14 (base)
 c. 3 (acid)
 d. 1 (acid)

pH Scale Super Summary Chart

pH Change	$[H_3O^+]$ increase or decrease	$[OH^-]$ increase or decrease	More acidic or more basic?	By a factor of...
6 to 8	↓	↑	basic	100 10^2
8 to 5	↑	↓	acid	1000 10^3
3 to 7	↓	↑	basic	10000 10^4
11 to 9	↑	↓	acidic	100 10^2
14 to 13	↓ ↑	↓	acidic	10 10^1
4 to 8	↓	↑	basic	10000 10^4

