pH

Section 9.6

The pH Scale

- Because $[H_3O^+]$ is so small, we need a more convenient scale to work with
- Using logarithms to convert, we use the pH scale to determine acidity and basicity
- pH scale is between 0 and 14, no units for pH

$$\boxed{pH = -\log[H_3O^+]}$$

Logarithm

- A logarithm is an exponent of a power of ten

$\log(10^5) = 5$ $\log(10^{-10}) = -10$

- The number of **significant figures in the concentration** is equal to the number of **decimal places in the pH**

- When calculating pH, remember to take the **negative** log

$-\log(10^5) = -5$ $-\log(10^{-10}) = -(-10) = 10$

Acidity/Basicity

- A neutral solution has a pH = 7
- An acidic solution has a pH < 7
- A basic solution has a pH > 7
- Because pH is the negative log of [H_3O^+], the higher the [H_3O^+] the lower the pH
  - Inverse relationship

Example #1

Convert each $[H_3O^+]$ to a pH value.

a. $[H_3O^+] = 1 \times 10^{-12}$ M

b. $[H_3O^+] = 2.5 \times 10^{-5}$ M

c. $[H_3O^+] = 4.3 \times 10^{-9}$ M

Example #1 Solved

a. $[H_3O^+] = 1 \times 10^{-12}$ M

$pH = -\log[H_3O^+] = -\log[1 \times 10^{-12}] = 12.0$

b. $[H_3O^+] = 2.5 \times 10^{-5}$ M

$pH = -\log[H_3O^+] = -\log[2.5 \times 10^{-5}] = 4.60$

c. $[H_3O^+] = 4.3 \times 10^{-9}$ M

$pH = -\log[H_3O^+] = -\log[4.3 \times 10^{-9}] = 8.37$

Calculating $[H_3O^+]$

- When given the pH of a solution, it is possible to determine the $[H_3O^+]$
- $[H_3O^+] = 10^{-pH}$
- The number of **significant figures in the concentration** is equal to the number of **decimal places in the pH**

Example #2

What $[H_3O^+]$ corresponds to each pH value?

a. 10.2

b. 7.8

c. 4.3

Example #2 Solved

a. 10.2

$[H_3O^+] = 10^{-pH} = 10^{-10.2} = 6 \times 10^{-11}$ M

b. 7.8

$[H_3O^+] = 10^{-pH} = 10^{-7.8} = 2 \times 10^{-8}$ M

c. 4.3

$[H_3O^+] = 10^{-pH} = 10^{-4.3} = 5 \times 10^{-5}$ M

Example #3

Convert each concentration to a pH value.

a. $[OH^-] = 2 \times 10^{-12}$ M

b. $[H_3O^+] = 4.7 \times 10^{-3}$ M

c. $[OH^-] = 8.6 \times 10^{-8}$ M

Example #4

What $[H_3O^+]$ corresponds to each pH value?

a. 2.1

b. 6.3

c. 11.47