The pH Scale

Chem Worksheet 19-3

Name _____

An **acid** is a substance that creates the **hydronium ion**, H_3O^+, in solution. The concentration of hydronium is represented by $[H_3O^+]$ and this value determines the pH of a solution. The pH is calculated by taking the logarithm of $[H_3O^+]$ and changing the sign: pH = -log $[H_3O^+]$. A neutral solution has a pH of 7, while acidic solutions have pH values less than 7. Basic or **alkaline** solutions have pH values greater than 7.

pH Scale

pH	$[H_3O^+]$	$[OH^-]$	pOH	
0	1×10^{0}	1×10^{-14}	14	More acidic
2	1×10^{-2}	1×10^{-12}	12	
4	1×10^{-4}	1×10^{-10}	10	
6	1×10^{-6}	1×10^{-8}	8	
7	1×10^{-7}	1×10^{-7}	7	neutral
8	1×10^{-8}	1×10^{-6}	6	
10	1×10^{-10}	1×10^{-4}	4	
12	1×10^{-12}	1×10^{-2}	2	
14	1×10^{-14}	1×10^{0}	0	More basic

USEFUL EQUATIONS

$$pH = -\log [H_3O^+]$$
$$pOH = -\log [OH^-]$$
$$pH + pOH = 14.00$$
$$[H_3O^+] \times [OH^-] = 1.0 \times 10^{-14}$$

Examples

Find the pH of a solution with $[H_3O^+] = 8.6 \times 10^{-9}$ *M*.

$pH = -\log [H_3O^+]$

$pH = -\log (8.6 \times 10^{-9})$

$pH = -(-8.07) = 8.07$

Find the pOH of a solution with $[OH^-] = 1.3 \times 10^{-2}$ *M*.

$pOH = -\log [OH^-]$

$pOH = -\log (1.3 \times 10^{-2})$

$pOH = -(-1.89) = 1.89$

Find the $[H_3O^+]$ of a solution with a pH = 9.27.

$pH = -\log [H_3O^+]$

$-pH = \log [H_3O^+]$

$\text{antilog} -(9.27) = \cancel{\text{antilog}}\ \cancel{\log}\ [H_3O^+]$

$5.4 \times 10^{-10}\ M = [H_3O^+]$

Find the pOH of a solution with pH = 3.21.

$pOH = 14.00 - pH$

$pOH = 14.00 - 3.21 = 10.79$

Solve the following problems. Show all work.

1. Find the pH of a solution with $[H_3O^+] = 2.3 \times 10^{-4}$ *M*. Is the solution acidic or basic?
2. Find the pH of a solution with $[H_3O^+] = 7.42 \times 10^{-11}$ *M*. Is the solution acidic or basic?
3. Vinegar (acetic acid) has a pH of about 2.4. Determine the $[H_3O^+]$ for vinegar. Is it acidic or basic?
4. Baking soda has a pH of about 8.15. Find the $[H_3O^+]$ for a baking soda solution. Is it acidic or basic?
5. Find the pOH for a solution with $[OH^-] = 5.5 \times 10^{-3}$ *M*. Is the solution acidic or basic?
6. Find the pOH for a solution with $[OH^-] = 3.71 \times 10^{-6}$ *M*. Is the solution acidic or basic?
7. A 0.05 *M* solution of NaOH contains 0.05 *M* OH^-. Find the pOH of this solution and convert to pH.
8. In a blood sample $[OH^-] = 3.2 \times 10^{-7}$ *M*. Find the pOH of blood and convert to pH.
9. The pOH of household ammonia is 2.5. Determine the $[OH^-]$ in ammonia. Is the solution acidic or basic?
10. Lemon juice has a pH of about 3.6. Determine the $[H_3O^+]$ in lemon juice. Is it acidic or basic?