6.3 Ionization of Water Assignment

1. The concentration of either the H^+ ion of OH^- ion is given for 3 aqueous solutions at 298K. For each solution, calculate $[H^+]$ or $[OH^-]$. State whether solution is acidic, basic or neutral.

a) $[H^+] = 1.0 \times 10^{-13}M$

$K_w = [H_3O^+][OH^-]$

$1.0 \times 10^{-14} = (1.0 \times 10^{-13}M)[OH^-]$ $\quad [OH^-] > [H^+]$

$[OH^-] = 1.0 \times 10^{1}M$ $\quad \therefore$ basic

b) $[OH^-] = 1.0 \times 10^{-7}M$

$K_w = [H_3O^+][OH^-]$

$1.0 \times 10^{-14} = [H_3O^+](1.0 \times 10^{-7}M)$

$[H_3O^+] = 1.0 \times 10^{-7}M$

$\therefore$ neutral

c) $[OH^-] = 1.0 \times 10^{-3}M$

$K_w = [H^+][OH^-]$ $\quad [H^+] < [OH^-]$

$1.0 \times 10^{-14} = [H^+](1.0 \times 10^{-3}M)$

$[H^+] = 1.0 \times 10^{-11}M$ $\quad \therefore$ basic

2. What is the $[H_3O^+]$ in a 0.025M solution of NaOH. Is this solution acidic, basic or neutral?

$NaOH_{(s)} \rightarrow Na^+ + OH^-$

$K_w = [H_3O^+][OH^-]$

$1.0 \times 10^{-14} = [H_3O^+](0.025M)$

$[H_3O^+] = 4.0 \times 10^{-13}$

$[H_3O^+] < [OH^-]$ $\quad \therefore$ basic

$HI = 1.01 + 126.904 = 128\ g/mol$

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3. A 2.5L solution contains 5.6 g of hydroiodic acid. What is the concentrati of hydroxide ions in this solution? Is this solution acidic, basic or neutral?

$$M = \frac{wt}{mm \cdot V} = \frac{5.6g}{(128g/mol)(2.5L)} = 0.0175M$$

$$HI_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + I^-_{(aq)}$$

$$K_w = [H_3O^+][OH^-]$$

$$1.0 \times 10^{-14} = (0.0175M)[OH^-]$$

$$[OH^-] = 5.7 \times 10^{-13} \quad \therefore \text{ acidic}$$

4. Postassium hydroxide is a very strong base. If 6 mols are found in an 8L solution, what is the hydronium ion concentration in this solution? Is this solution acidic, basic or neutral?

$$M = \frac{6\ mol}{8L} = 0.75M$$

$$K_w = [OH^-][H^+]$$

$$1.0 \times 10^{-14} = (0.75M)[H^+]$$

$$[H^+] = 1.3 \times 10^{-14} \quad \therefore \text{ basic}$$

5. 10.4 g of nitric acid are found in 750 mL of water. What is the hydronium concentration of this solution?

K - 14.01
H - 1.01
O - 16x3
63.02

$$M = \frac{wt}{mm \cdot V} = \frac{10.4g}{(63.02g/mol)(.750L)} = 0.2200M$$

$$HNO_3 + H_2O \rightarrow H_3O^+ + NO_3^-$$

$0.22M$ $\quad$ $0.22M$ b/c 1:1 ratio in strong acid

6. A 500mL (0.50M) solution of sodium hydroxide is diluted with 250mL of water. What are the final concentrations of $[H^+]$ and $[OH^-]$ in this solution? this solution acidic, basic or neutral?

$$M_1V_1 = M_2V_2$$

$$(0.50M)(0.5L) = M_2(0.75L)$$

$$M_2 = 0.33M = [OH^-]$$

$$K_w = [OH^-][H_3O^+]$$

$$1.0 \times 10^{-14} = [H_3O^+](0.33M) = 3.0 \times 10^{-14}$$

$$[H_3O^+] = 3.0 \times 10^{-14}\ M < 1.0 \times 10^{-7}$$

$\therefore$ basic