CONCEPT: SYSTEMATIC APPROACH – ACID-BASE SYSTEMS

Strong Acids and Bases are considered _____ Electrolytes so they ionize completely in water.

- In general, the _____ the K_a the stronger the acid and the _____ the concentration of H^+.

$$\underset{0.200\ M}{HCl\ (aq)} \xrightarrow{H_2O} \underset{0.200\ M}{H^+\ (aq)} + \underset{0.200\ M}{Cl^-\ (aq)}$$

HCl	$K_a = 10^{3.9} = 7.94 \times 10^3$
HBr	$K_a = 10^{5.8} = 6.31 \times 10^5$
HI	$K_a = 10^{10.4} = 2.51 \times 10^{10}$
HNO_3	$K_a = 10^{1.4} = 25.1$
H_2SO_4	$K_a = 10^3 = 1.0 \times 10^3$
$HClO_4$	$K_a = \infty$
$HClO_3$	$K_a = 10^0 = 1.0$

When calculating the pH of a solution we must take into consideration the concentration of the strong acid or base.

Concentration $\geq 10^{-6}$ M

The concentrations of either of H^+ and OH^- are significant enough to determine pH and pOH directly.

$$\underset{1.5 \times 10^{-3}\ M}{HNO_3\ (aq)} \xrightarrow{H_2O} \underset{1.5 \times 10^{-3}\ M}{H^+\ (aq)} + \underset{1.5 \times 10^{-3}\ M}{NO_3^-\ (aq)}$$

$$\underset{0.00075\ M}{NaOH\ (aq)} \xrightarrow{H_2O} \underset{0.00075\ M}{Na^+\ (aq)} + \underset{0.00075\ M}{OH^-\ (aq)}$$

Concentration $\leq 10^{-8}$ M

The concentrations either of H^+ and OH^- are too small to be significant and so pH equals _____.

$$\underset{8.4 \times 10^{-11}\ M}{HNO_3\ (aq)} \xrightarrow{H_2O} \underset{8.4 \times 10^{-11}\ M}{H^+\ (aq)} + \underset{8.4 \times 10^{-11}\ M}{NO_3^-\ (aq)}$$

$$\underset{7.0 \times 10^{-9}\ M}{NaOH\ (aq)} \xrightarrow{H_2O} \underset{7.0 \times 10^{-9}\ M}{Na^+\ (aq)} + \underset{7.0 \times 10^{-9}\ M}{OH^-\ (aq)}$$

Between 10^{-6} M to 10^{-8} M

The concentrations of H^+ and OH^- must compete with the auto-ionization of water so a systematic approach is used.

PRACTICE: SYSTEMATIC APPROACH – ACID-BASE SYSTEMS CALCULATIONS 1

EXAMPLE: Determine the pH of a 3.5×10^{-8} M HBr.

PRACTICE: Determine the pH of a 6.7×10^{-8} M NaOH.