Chem12 Mixing Acids and Bases-50

If we add unequal amounts of a strong acid and a strong base to water, then the equilibrium :

$$2H_2O(l) <-> H_3O^+(aq) + OH^-(aq)$$

will shift and there will be a reaction until $[H_3O^+][OH^-] = 1.0x10^{-14}$, so K_w will remain constant unless the temperature changes.

Example : If 40. mL of 0.60 M NaOH reacts with 25 mL of 0.40 M, HCl, find the final concentrations of $H_3O^+(aq)$ and $OH^-(aq)$. (Total volume = 0.065 L)

$[OH^-]initial = 0.040x(0.60/0.065) = 0.37$ M

$[H_3O^+]initial = 0.025x(0.40/0.065) = 0.15$ M

There is a higher initial concentration of OH^- than H_3O^+ so the solution will be basic. The excess $[OH^-]$ is 0.37 - 0.15 = 0.22 M. (to a very good approximation)

The final concentration of $[OH^-] = 0.22$ M

The final concentration of $[H_3O^+] = 1.0x10^{-14}/0.22 = 4.5x10^{-14}$ M.

Problems :

1) Find the final concentrations of OH^- and H_3O^+ in a mixture of 50. mL of 0.0010 M HCl. and 30. mL of 0.0020 M NaOH.

2) Find the final concentrations of OH^- and H_3O^+ in a mixture of 35 mL of 0.40 M HCl and 25 mL of 0.45 M of NaOH.

3) Find the final concentrations of OH^- and H_3O^+ in a mixture of 65 mL of 0.30 M HNO_3 and 250 mL of 0.20 M $Ca(OH)_2$ solution.

Answers : 1) $[OH^-] = 1.3x10^{-4}$, $[H_3O^+] = 8.0x10^{-11}$, 2) $[OH^-] = 2.2x10^{-13}$, $[H_3O^+] = 0.046$, 3) $[OH^-] = 0.26$, $[H_3O^+] = 3.9x10^{-14}$.