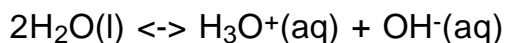


## Chem12 Mixing Acids and Bases-50

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



will shift and there will be a reaction until  $[\text{H}_3\text{O}^+][\text{OH}^-] = 1.0 \times 10^{-14}$  , 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  $\text{H}_3\text{O}^+(\text{aq})$  and  $\text{OH}^-(\text{aq})$ . (Total volume = 0.065 L)

$$[\text{OH}^-]_{\text{initial}} = 0.040 \times (0.60/0.065) = 0.37 \text{ M}$$

$$[\text{H}_3\text{O}^+]_{\text{initial}} = 0.025 \times (0.40/0.065) = 0.15 \text{ M}$$

There is a higher initial concentration of  $\text{OH}^-$  than  $\text{H}_3\text{O}^+$  so the solution will be basic. The excess  $[\text{OH}^-]$  is  $0.37 - 0.15 = 0.22 \text{ M}$ . (to a very good approximation)

The final concentration of  $[\text{OH}^-] = 0.22 \text{ M}$

The final concentration of  $[\text{H}_3\text{O}^+] = 1.0 \times 10^{-14} / 0.22 = 4.5 \times 10^{-14} \text{ M}$ .

Problems :

- 1) Find the final concentrations of  $\text{OH}^-$  and  $\text{H}_3\text{O}^+$  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  $\text{OH}^-$  and  $\text{H}_3\text{O}^+$  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  $\text{OH}^-$  and  $\text{H}_3\text{O}^+$  in a mixture of 65 mL of 0.30 M  $\text{HNO}_3$  and 250 mL of 0.20 M  $\text{Ca}(\text{OH})_2$  solution.

Answers : 1)  $[\text{OH}^-] = 1.3 \times 10^{-4}$ ,  $[\text{H}_3\text{O}^+] = 8.0 \times 10^{-11}$ , 2)  $[\text{OH}^-] = 2.2 \times 10^{-13}$ ,  $[\text{H}_3\text{O}^+] = 0.046$ , 3)  $[\text{OH}^-] = 0.26$ ,  $[\text{H}_3\text{O}^+] = 3.9 \times 10^{-14}$ .