

## Ionic Equilibriums in Water



#9

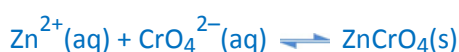
15.00 mL  $0.120 \frac{\text{mol}}{\text{L}}$   $\text{Zn}(\text{NO}_3)_2$  and 10.00 mL  $0.100 \frac{\text{mol}}{\text{L}}$   $\text{Na}_2\text{CrO}_4$  are poured together. The solubility product of  $\text{ZnCrO}_4$  is  $2.5 \cdot 10^{-9}$ . Will a precipitation be formed or not? If so, which one?

### Solution

The following ions are present in the mixture:  $\text{Zn}^{2+}$ ,  $\text{NO}_3^-$ ,  $\text{Na}^+$  and  $\text{CrO}_4^{2-}$ .

In theory, two precipitations can be formed:  $\text{ZnCrO}_4$  and  $\text{NaNO}_3$ .

The precipitation of  $\text{NaNO}_3$  will not be formed: the solubility of  $\text{NaNO}_3$  in water is very large.



This precipitation will only occur when  $[\text{Zn}^{2+}] \times [\text{CrO}_4^{2-}] > K_{sp\text{ZnCrO}_4} (= 2.5 \times 10^{-9})$ .

The concentration of  $\text{Zn}^{2+}$  in the mixture is

$$\frac{15.00 \times 10^{-3} \text{L} \times 0.120 \frac{\text{mol}}{\text{L}}}{25.00 \times 10^{-3} \text{L}} = \frac{1.80 \times 10^{-3} \text{mol}}{25.00 \times 10^{-3} \text{L}} = 7.20 \times 10^{-2} \frac{\text{mol}}{\text{L}}$$

The concentration of  $\text{CrO}_4^{2-}$  in the mixture is

$$\frac{10.00 \times 10^{-3} \text{L} \times 0.100 \frac{\text{mol}}{\text{L}}}{25.00 \times 10^{-3} \text{L}} = \frac{1.00 \times 10^{-3} \text{mol}}{25.00 \times 10^{-3} \text{L}} = 4.00 \times 10^{-2} \frac{\text{mol}}{\text{L}}$$

So:

$$[\text{Zn}^{2+}] \times [\text{CrO}_4^{2-}] = (7.20 \times 10^{-2}) \times (4.00 \times 10^{-2}) = 2.88 \times 10^{-3} > K_{sp\text{ZnCrO}_4} (= 2.5 \times 10^{-9})$$

So there will be a precipitation of  $\text{ZnCrO}_4$ .