

- A standard test for the presence of chloride ion in water involves the appearance of a precipitate of AgCl upon addition of 0.05 mL of AgNO<sub>3</sub> (0.03 M) to 100 mL of sample. What is the minimum concentration of Cl<sup>-</sup> detectable by this method? The  $K_{sp}$  of AgCl =  $1.8 \times 10^{-10}$ .

**The number of moles of Ag<sup>+</sup>(aq) in 0.05 mL of a 0.03 M solution of AgNO<sub>3</sub>(aq) is:**

$$\begin{aligned}\text{number of moles} &= \text{concentration} \times \text{volume} \\ &= (0.03 \text{ mol L}^{-1}) \times (0.05 \times 10^{-3} \text{ L}) = 1.5 \times 10^{-6} \text{ mol}\end{aligned}$$

**When this is added to 100. mL of the sample:**

$$\begin{aligned}[\text{Ag}^+(\text{aq})] &= \text{number of moles} / \text{volume} \\ &= (1.5 \times 10^{-6} \text{ mol}) / (0.100 \text{ L}) = 1.5 \times 10^{-5} \text{ M}\end{aligned}$$

**For AgCl(s),  $K_{sp} = [\text{Ag}^+(\text{aq})][\text{Cl}^-(\text{aq})]$  and so:**

$$[\text{Cl}^-(\text{aq})] = K_{sp} / [\text{Ag}^+(\text{aq})] = 1.8 \times 10^{-10} / 1.5 \times 10^{-5} = 1.2 \times 10^{-5}$$

Answer:  $1.2 \times 10^{-5}$