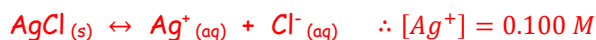


Applications of Solubility

- 1.) When 25.0 mL of NaCl solution having an unknown concentration is titrated with 0.100 M AgNO₃, using chromate ion as an indicator, 36.8 mL of the AgNO₃ solution are required to reach the equivalence point.

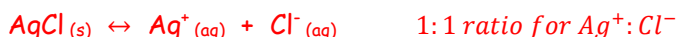
What is the [Cl⁻]?



Answers - $\frac{0.100 \text{ mol Ag}^+}{1 \text{ L}} \times 0.0368 \text{ L} = 0.00368 \text{ mol Ag}^+ \quad \therefore \text{Cl}^- = 0.00368 \text{ mol}$

$$0.00368 \text{ mol Cl}^- \times \frac{1}{0.0250 \text{ L}} \quad [\text{Cl}^-] = 0.1472 \text{ M} \quad \underline{[\text{Cl}^-] = 0.147 \text{ M}}$$

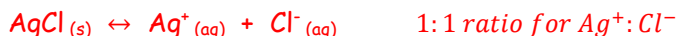
- 2.) What volume of 0.0988 M Cl solution is required to titrate 25.0 mL of 0.0750 M AgNO₃, using chromate indicator?



Answers - $\text{mol Ag}^+ = \frac{0.0750 \text{ mol}}{1 \text{ L}} \times 0.0250 \text{ L} \quad \text{mol Ag}^+ = 0.001875 \quad \therefore \text{Cl}^- = 0.001875 \text{ mol}$

$$0.001875 \text{ mol Cl}^- \times \frac{1 \text{ L}}{0.0988 \text{ mol}} \quad \text{volume of Cl}^- = 0.018977 \text{ L} \quad \underline{\text{Cl}^- = 19.0 \text{ mL}}$$

- 3.) A solution of potassium chloride is made by dissolving 3.25 g KCl in water and diluting to 500.0 mL. If 9.48 mL AgNO₃ solution is required to titrate 25.00 mL of the KCl solution, what is the molar concentration of the AgNO₃?



Answers - $\text{mol Cl}^- = \frac{3.25 \text{ g KCl}}{0.500 \text{ L}} \times \frac{1 \text{ mol}}{74.55 \text{ g}} \times 0.025 \text{ L} \quad \text{mol Cl}^- = 0.002179 \text{ mol} \quad \therefore \text{Ag}^+ = 0.002179 \text{ mol}$

$$0.002179 \text{ mol Ag}^+ \times \frac{1}{0.00948 \text{ L}} \quad [\text{Ag}^+] = 0.22993 \text{ M} \quad \underline{[\text{Ag}^+] = 0.230 \text{ M}}$$

- 4.) A student is assigned the task of finding the K_{sp} value for silver acetate. Several grams of AgCH₃COO_(s) are added to distilled water and stirred overnight. The next day a 50.0 mL sample of the saturated AgCH₃COO solution is titrated with 30.6 mL of 0.100 M NaCl. What is the value of K_{sp} for AgCH₃COO?

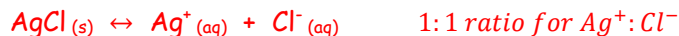


$$\text{mol Cl}^- = \frac{0.100 \text{ mol NaCl}}{1 \text{ L}} \times 0.0306 \quad \text{mol Cl}^- = 0.00306 \quad \therefore \text{Ag}^+ = 0.00306 \text{ mol}$$

$$0.00306 \text{ mol mol Ag}^+ \times \frac{1}{0.0500 \text{ L}} \quad [\text{Ag}^+] = 0.612 \text{ M}$$

$$K_{sp} = (0.612)(0.612) \quad K_{sp} = 3.74544 \times 10^{-3} \quad \underline{K_{sp} = 3.75 \times 10^{-3}}$$

5.) A 4.75 g silver coin was dissolved in nitric acid and the resulting solution diluted to 250. mL. When a 25.0 mL sample of 0.200 M NaCl was titrated with the silver solution, using chromate indicator, 28.8 mL of silver solution was required. What was the percentage purity of the silver in the coin, assuming any impurities present were unreactive?



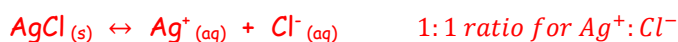
Answers - $\text{mol Cl}^- = \frac{0.200 \text{ mol NaCl}}{1 \text{ L}} \times 0.0250 \text{ L} \quad \text{mol Cl}^- = 0.00500 \quad \therefore \text{Ag}^+ = 0.00500 \text{ mol}$

$$0.00500 \text{ mol mol Ag}^+ \times \frac{1}{0.0288 \text{ L}} \quad [\text{Ag}^+] = 0.173611 \text{ M}$$

$$\frac{0.17636 \text{ mol Ag}^+}{1 \text{ L}} \times \frac{107.87 \text{ g}}{1 \text{ mol}} \times 0.250 \text{ L} \quad \text{Ag} = 4.681857 \text{ g} \quad \% \text{ Ag} = \frac{4.681857}{4.75} \times 100 \quad \% \text{ Ag} = 98.6 \%$$

6.) A 95.6 g sample of chicken from a restaurant was checked for Cl⁻ (in the form of NaCl) as follows. The chicken was blended with water and suction filtered. The solution obtained was then diluted to 1.00 L. A 25.0 mL sample of the solution was titrated with 0.0200 M AgNO₃ solution, using chromate indicator, and 15.3 mL was found to be needed.

a.) What was the [Cl⁻] in the solution?



Answers - $\text{mol Ag}^+ = \frac{0.0200 \text{ mol Ag}^+}{1 \text{ L}} \times 0.0153 \text{ L} \quad \text{mol Ag}^+ = 3.06 \times 10^{-4} \quad \therefore \text{Cl}^- = 3.06 \times 10^{-4} \text{ mol}$

$$3.06 \times 10^{-4} \text{ mol Cl}^- \times \frac{1}{0.0250 \text{ L}} \quad [\text{Cl}^-] = 0.01224 \text{ M} \quad [\text{Cl}^-] = 0.0122 \text{ M}$$

b.) How many grams of the NaCl were extracted from the meat?

Answers - $\frac{0.01224 \text{ mol Cl}^-}{1 \text{ L}} \times \frac{58.44 \text{ g}}{1 \text{ mol}} \times 1 \text{ L} \quad \text{NaCl} = 0.715305 \text{ g} \quad \text{NaCl} = 0.715 \text{ g}$

c.) What was the percentage of NaCl in the original chicken sample?

Answers - $\% \text{ NaCl} = \frac{0.715305}{95.6} \times 100 \quad \% \text{ NaCl} = 0.748 \%$