

Lecture Quiz 1 Key

The precipitation titration of 15.0 mL of AgNO_3 required 25.0 mL of .0360 M NaCl to reach equivalence. The K_{sp} of AgCl is 1.8×10^{-10} .

(1) What is the $\text{pAg}^+_{\text{free}}$ when 5.0 mLs of the NaCl titrant has been added to the AgNO_3 analyte?

Answer B. 2.07

Solution: first get $[\text{Ag}]_o$:

Write the titration reaction: $\text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl}(s)$ (presumed to be 100% completed)

At equivalence, #mol Ag = #mol Cl : so $M_1V_1 = M_2V_2$

$$[\text{Ag}]_o = M_{\text{Cl}}V_{\text{Cl}}/V_{\text{Ag}} = (.0360\text{M})(25.0\text{mL})/(15.0\text{mL}) = .0600\text{M Ag}^+$$

So after only 5 mLs of Cl^- has been added:

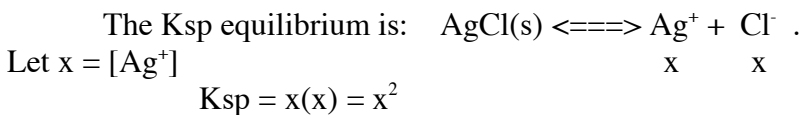
$$[\text{Ag}] = [\text{Ag}]_o(\text{fraction})(\text{dilution}) = (0.0600)(5/25)(15/20) = 0.00900\text{M}$$

$$\Rightarrow \text{pAg}^+ = -\log[\text{Ag}^+] = -\log(.00900) = \mathbf{2.05}$$

(2) What is the $\text{pAg}^+_{\text{free}}$ when 25.0 mLs of the NaCl titrant has been added to the AgNO_3 analyte?

Answer: D 4.87

Solution: We note that 25.0 mLs is exactly equal to the equivalence point. That is the point at which we use the K_{sp} equilibrium (otherwise, we would continue to use the assumption that the precipitation is 100% completed and that would leave no Ag^+ left in solution, which violates the K_{sp} equilibrium).

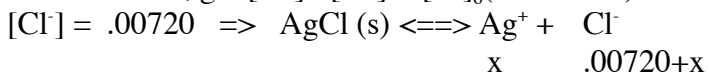


$$[\text{Ag}]^2 = 1.8 \times 10^{-10} \Rightarrow [\text{Ag}^+] = 1.34 \times 10^{-5}\text{M} \Rightarrow \mathbf{4.87}$$

(3) OK: here's another one. (don't look at the answer just do the problem)

What is the $\text{pAg}^+_{\text{free}}$ when 35.0 mLs of the NaCl titrant has been added to the AgNO_3 analyte?

Solution: first, get $[\text{Cl}^-]$: $[\text{Cl}^-] = [\text{Cl}^-]_o(\text{excess vol})/\text{total vol} = (0.0360)(10)/(50)$



$$\text{so } x(.00720) \approx 1.8 \times 10^{-10} : x \approx (1.8 \times 10^{-10})/(.00720) = 2.5 \times 10^{-8}\text{M} \Rightarrow \text{pAg} = 7.6$$