Titrations

a solution of accurately known concentration, called a *standard solution*, is added gradually to another solution of unknown concentration, until the chemical reaction between the two solutions is complete.

Mohr ChlorideTitrations

depend on the solubility of the two silver precipitates, AgCl and Ag_2CrO_4.

If Ag^+ ion is added to a solution containing both Cl^- and CrO_4^{2-} ions , the AgCl will be precipitated first, because it is "less soluble in water" than the Ag_2CrO_4 .

When all the chloride ion has been precipitated, the Ag_2CrO_4 starts to precipitate and the color changes from a creamy yellow to an orange.

$$AgNO_3(aq) + NaCl(aq) \longrightarrow AgCl(s) + NaNO_3(aq)$$

$$Ag^+(aq) + NO_3^-(aq) + Na^+(aq) + Cl^-(aq)$$

$$AgCl(s) + Na^+(aq) + NO_3^-(aq)$$

$$AgNO_3(aq) + NaCl(aq) \longrightarrow AgCl(s) + NaNO_3(aq)$$

$$Ag^+(aq) + NO_3^-(aq) + Na^+(aq) + Cl^-(aq)$$

$$AgCl(s) + Na^+(aq) + NO_3^-(aq)$$

$$AgNO_3(aq) + NaCl(aq) \longrightarrow AgCl(s) + NaNO_3(aq)$$

$$Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$$

$$2AgNO_3(aq) + K_2CrO_4(aq) \longrightarrow Ag_2CrO_4(s) + 2KNO_3(aq)$$

$$2Ag^+(aq) + 2NO_3^-(aq) + 2K^+(aq) + CrO_4^{2-}(aq)$$

$$Ag_2CrO_4(s) + 2K^+(aq) + 2NO_3^-(aq)$$

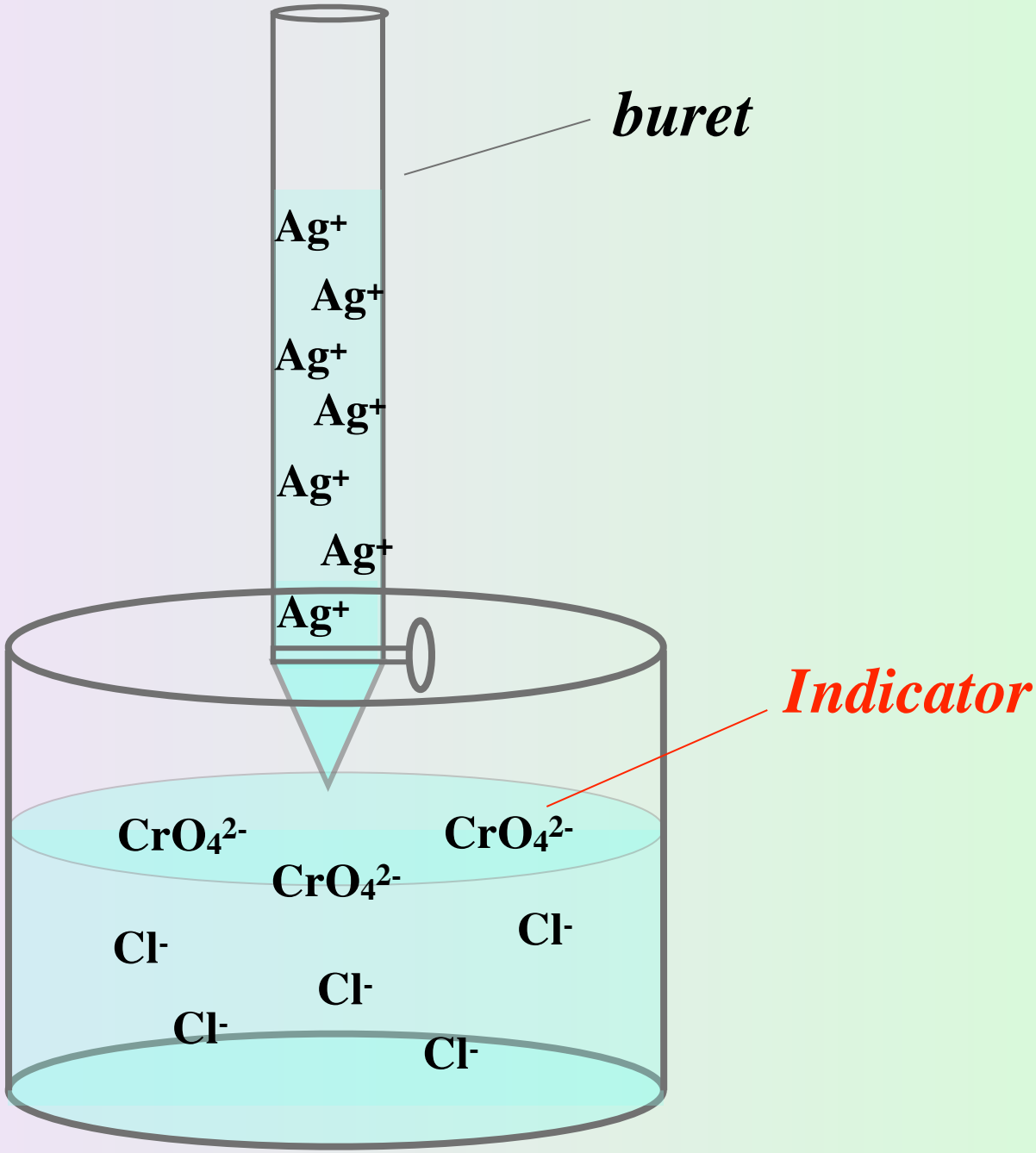
$$2AgNO_3(aq) + K_2CrO_4(aq) \longrightarrow Ag_2CrO_4(s) + 2KNO_3(aq)$$

$$2Ag^+(aq) + 2NO_3^-(aq) + 2K^+(aq) + CrO_4^{2-}(aq)$$

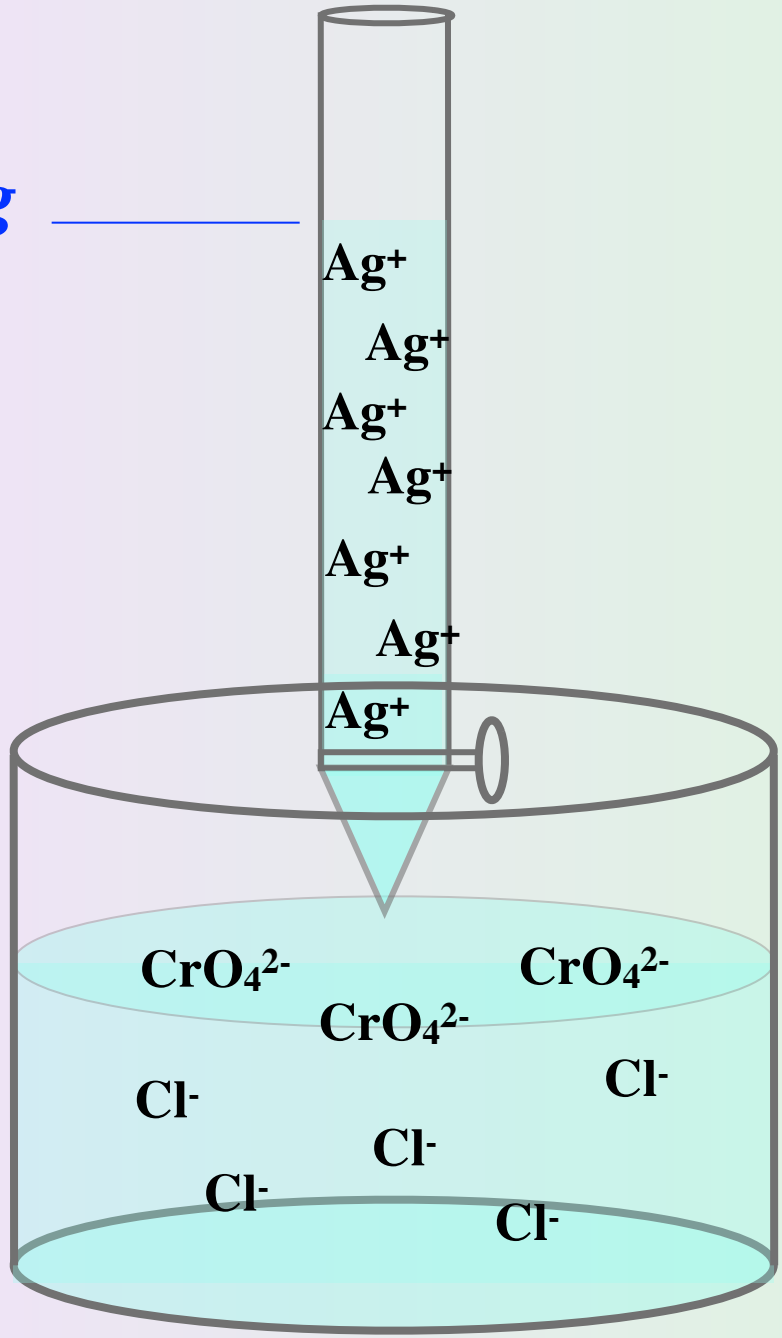
$$Ag_2CrO_4(s) + 2K^+(aq) + 2NO_3^-(aq)$$

$$2AgNO_3(aq) + K_2CrO_4(aq) \longrightarrow Ag_2CrO_4(s) + 2KNO_3(aq)$$

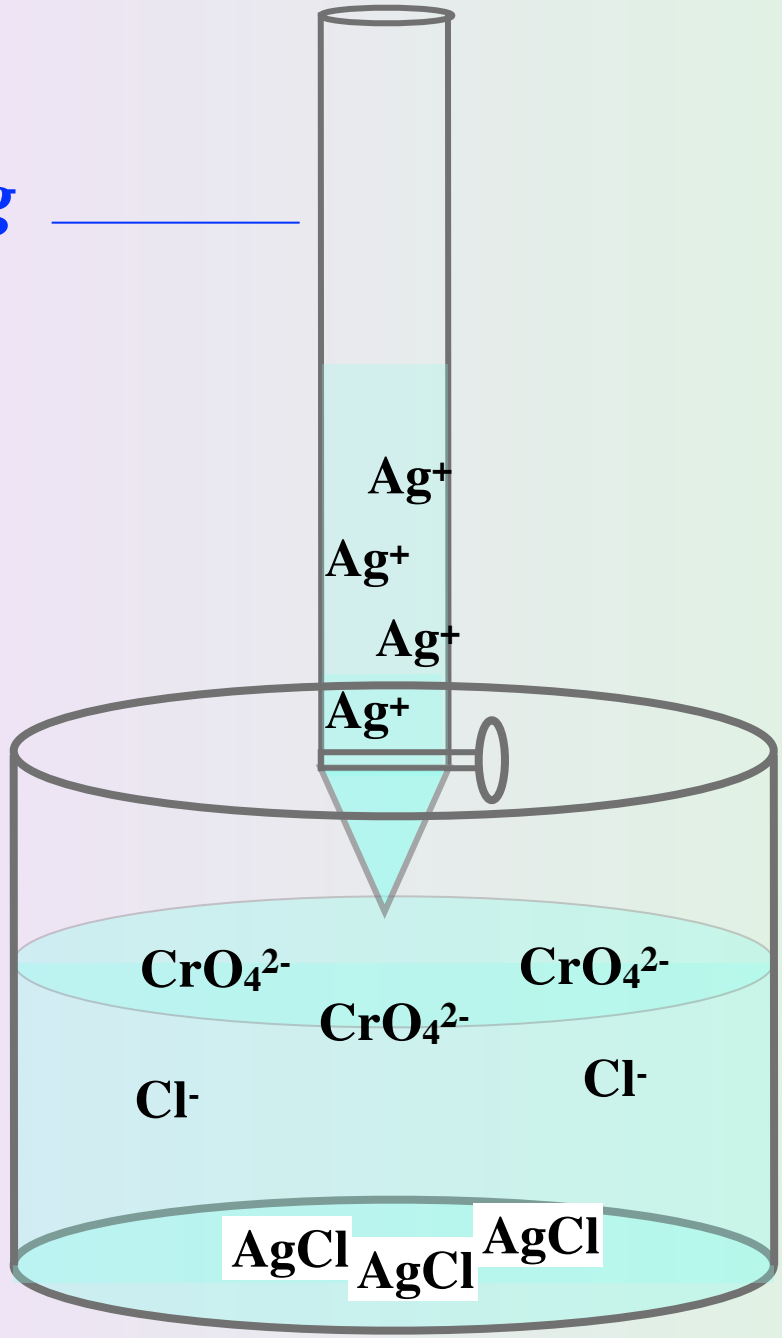
$$2Ag^+(aq) + CrO_4^{2-}(aq) \longrightarrow Ag_2CrO_4(s)$$


buret
Ag+
Ag+
Ag+
Ag+
Ag+
Ag+
Ag+
Indicator
CrO4 2-
CrO4 2-
CrO4 2-
Cl-
Cl-
Cl-
Cl-
Cl-

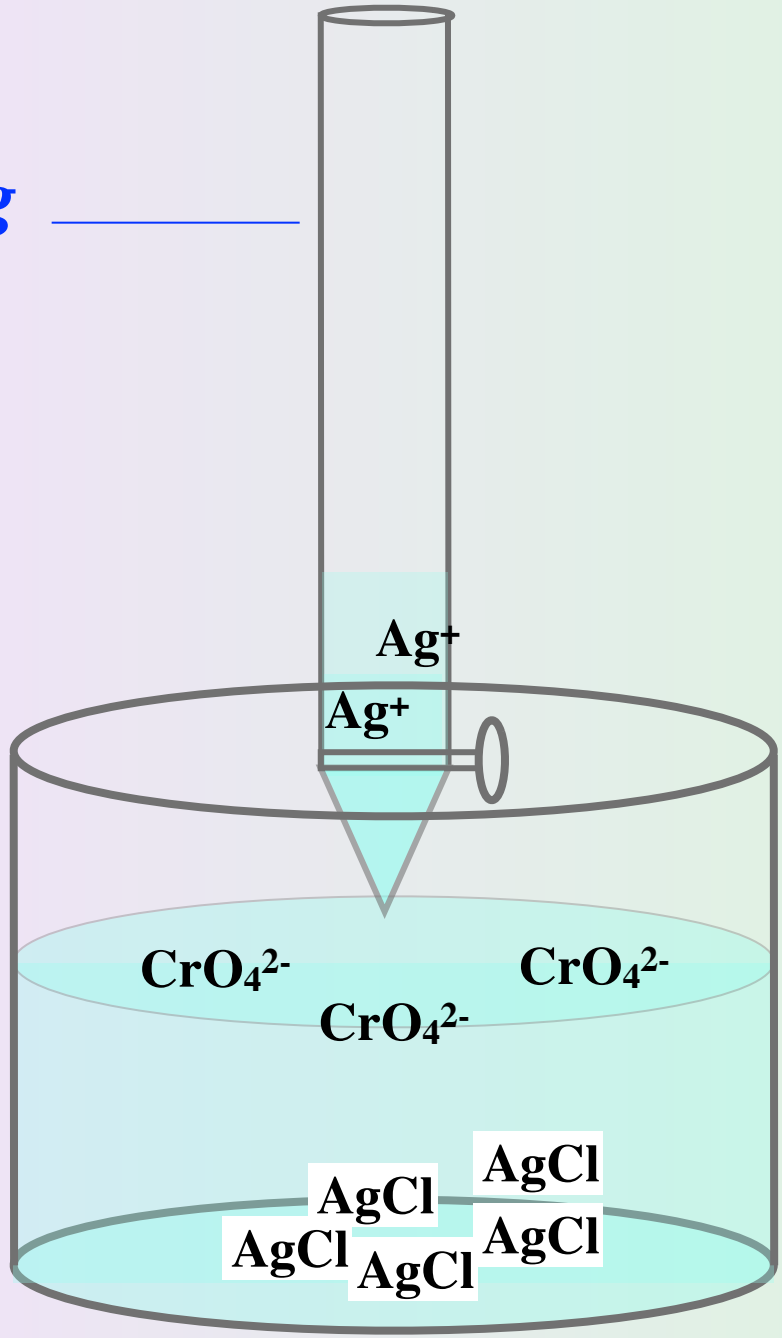
initial reading _____

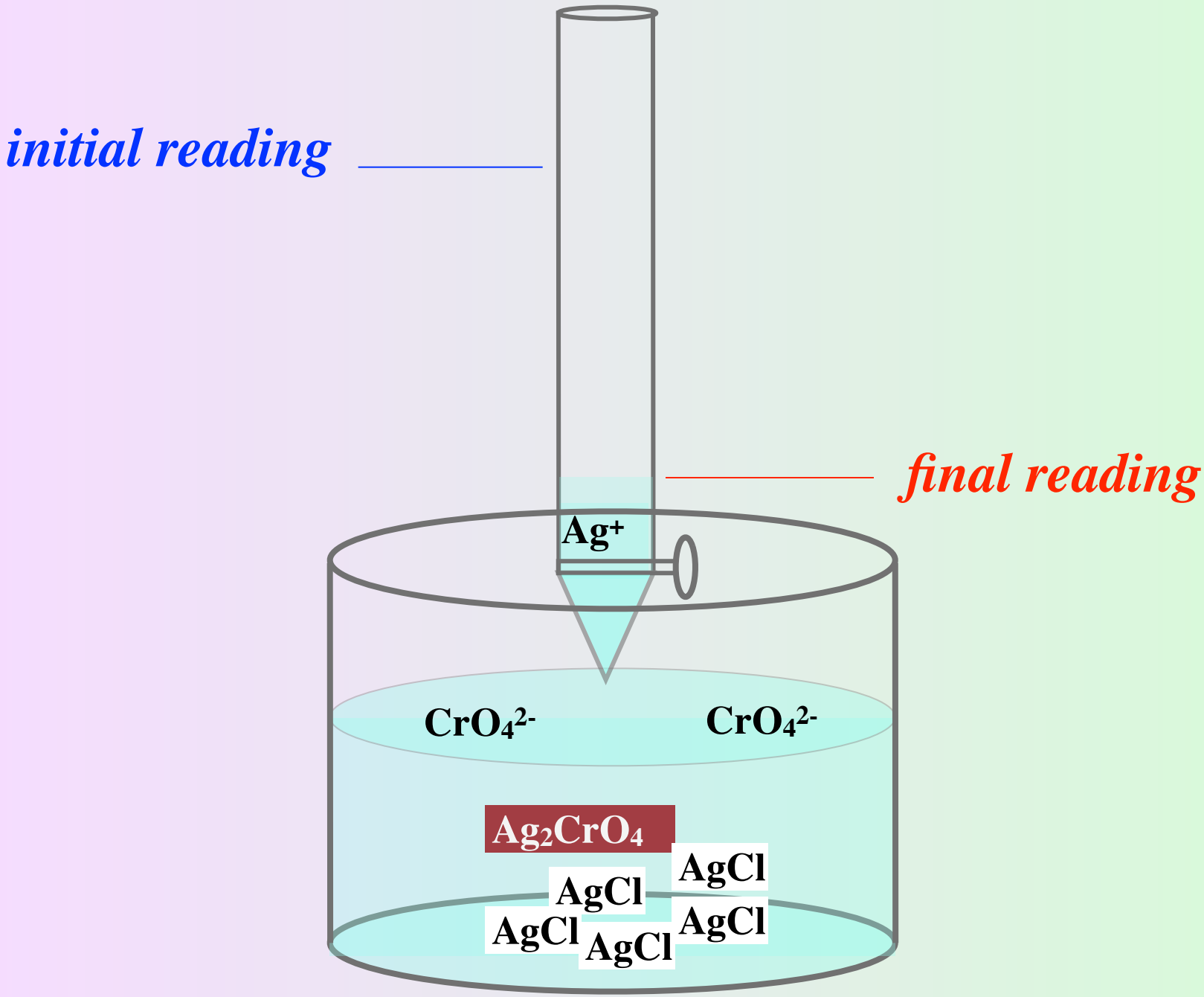


initial reading _____



initial reading _____




initial reading
final reading
Ag+
CrO4 2-
CrO4 2-
Ag2CrO4
AgCl
AgCl
AgCl
AgCl
AgCl

The Blank

a blank is used to correct for any chloride ion that may be present in the water being used.

It normally has a value of about 0.2 - 0.3 ml,

and must be subtracted from the amount of $AgNO_3$ solution used in the analysis of the *filtrate solution* sample.

Data Analysis

1. Average the blank titration values

2. Average the sample titration values. Subtract the average blank value from the average sample value

3. Using the ratio, $\frac{0.8250\text{mg NaCl}}{1\text{ ml } AgNO_3}$ calculate mg NaCl per gram of sample.

needed for a conversion factor $\frac{600.0\text{ ml filtrate}}{20.0\text{ g Fritos}}$

Data Analysis

3. Using the ratio, calculate mg NaCl per gram of sample.

$$\frac{(\text{avg ml } AgNO_3 \text{ used - blank})}{\text{10 ml filtrate}} \times \frac{0.8250\text{mg NaCl}}{1\text{ ml } AgNO_3} = \frac{\text{mg NaCl}}{\text{10 ml filtrate}}$$

$$\frac{\text{mg NaCl}}{\text{10 ml filtrate}} \times \frac{600.0\text{ ml filtrate}}{\text{20.0 g Fritos}} = \frac{\text{mg NaCl}}{\text{1 g Fritos}}$$

Data Analysis

4. Calculate the mg NaCl in the entire package of Fritos

$$\frac{280\ \text{g Fritos}}{1\ \text{package}} \times \frac{\text{mg NaCl}}{1\ \text{g Fritos}} = \frac{\text{mg NaCl}}{1\ \text{package}}$$

The solubility concentrations are $AgCl = 1.3 \times 10^{-5}$ M and $Ag_2CrO_4 = 1.3 \times 10^{-4}$ M.