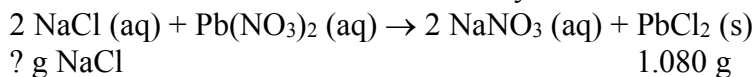


Ch. 4.6 Gravimetric Analysis

- Gravimetric Analysis

- Analytical technique based on measurement of mass of a product
- Precipitation reaction to determine concentration/moles/mass of one ion in solution:
 - 5.000 g of an impure sample of NaCl was dissolved in water to give a 100.0 mL solution. 10.00 mL of the solution yields 1.080 g PbCl₂ when mixed with a solution of excess Pb(NO₃)₂. What is the mass percent of NaCl in the original sample?

- First write the reaction for stoichiometry:



- Next find the mass of NaCl in the 10.00-mL sample:

$$? \text{ g NaCl} = 1.080 \text{ g PbCl}_2 \times \frac{1 \text{ mol PbCl}_2}{278.1 \text{ g PbCl}_2} \times \frac{2 \text{ mol NaCl}}{1 \text{ mol PbCl}_2} \times \frac{58.44 \text{ g NaCl}}{1 \text{ mol NaCl}} = 0.4539 \text{ g NaCl}$$

- Next find the mass of NaCl in 100 mL of the solution:

$$? \text{ g NaCl} = 0.4539 \text{ g NaCl} \times \frac{100.0 \text{ mL solution}}{10.00 \text{ mL sample}} = 4.539 \text{ g NaCl}$$

- Finally find the mass % in the original sample: $\% \text{NaCl} = \frac{4.539 \text{ g NaCl}}{5.000 \text{ g Sample}} \times 100\% = 90.78\%$

- Calculate the volume of a 0.550 M NaCl(aq) solution that must be added to 1.50 L of a 0.100 M AgNO₃ solution to precipitate all of the Ag⁺ ions in the form of AgCl.

- First write equation: $\text{AgNO}_3 \text{ (aq)} + \text{NaCl (aq)} \rightarrow \text{AgCl(s)} + \text{NaNO}_3 \text{ (aq)}$

1.50 L of 0.100 M ? L of 0.550 M

- Next determine the moles of AgNO₃ = M×V = (0.100 mol/L)(1.50 L) = 0.150 mol AgNO₃

- Since there is a 1:1 ratio of AgNO₃ to NaCl, we have:

$$\text{mol NaCl} = \text{mol AgNO}_3 = 0.150 \text{ mol NaCl}$$

- Finally, the volume can be determined from:

$$? \text{ L NaCl(aq)} = 0.150 \text{ mol NaCl} \times \frac{1 \text{ L NaCl(aq)}}{0.550 \text{ mol NaCl}} = 0.273 \text{ L NaCl(aq)}$$

- When NaF(aq) and Pb(NO₃)₂ (aq) are mixed, PbF₂ precipitates. What mass of PbF₂ is formed when 0.800 L of 0.500 M Pb(NO₃)₂ (aq) and 2.00 L of 0.0250 M NaF are mixed?

- First, write equation: $2 \text{NaF (aq)} + \text{Pb(NO}_3)_2 \text{ (aq)} \rightarrow \text{PbF}_2 \text{ (s)} + 2 \text{NaNO}_3 \text{ (aq)}$

- Next, determine *limiting reactant*:

$$\text{mol PbF}_2 \text{ from NaF} = 2.00 \text{ L NaF} \times \frac{0.0250 \text{ mol NaF}}{1 \text{ L NaF}} \times \frac{1 \text{ mol PbF}_2}{2 \text{ mol NaF}} = 0.0250 \text{ mol PbF}_2$$

$$\text{mol PbF}_2 \text{ from Pb(NO}_3)_2 = 0.800 \text{ L Pb(NO}_3)_2 \text{ (aq)} \times \frac{0.500 \text{ mol Pb(NO}_3)_2}{1 \text{ L Pb(NO}_3)_2 \text{ (aq)}} \times \frac{1 \text{ mol PbF}_2}{1 \text{ mol Pb(NO}_3)_2} = 0.400 \text{ mol PbF}_2$$

$$\text{NaF is limiting, so mass PbF}_2 = 0.0250 \text{ mol PbF}_2 \times \frac{245.2 \text{ g PbF}_2}{\text{mol PbF}_2} = 6.13 \text{ g PbF}_2$$