Example: You are given a 4.554 g sample that is a mixture of oxalic acid ($H_2C_2O_4$) and another solid that does not react with sodium hydroxide. If 29.58 mL of 0.550 M NaOH is required to titrate the sample, what is the weight percent of oxalic acid in the mixture?

$$H_2C_2O_4 + 2\ NaOH \rightarrow Na_2C_2O_4 + 2\ H_2O$$

In order to find the percent oxalic acid, we need to find the grams of oxalic acid in the original mixture. Since all of the oxalic acid is assumed to have reacted with NaOH, we should be able to use the reaction stoichiometry to do this. The thought process is that if we find moles NaOH, we can use the balanced reaction to find moles oxalic acid, and then convert to grams oxalic acid.

How many moles of NaOH did we use?

$$29.58\ \cancel{mL} \times \frac{1\ \cancel{L}}{1000\ \cancel{mL}} \times \frac{0.550\ mol\ NaOH}{1\ \cancel{L}} = 0.0162_{69}\ mol\ NaOH$$

How many moles of oxalic acid must have been present?

$$0.0162_{69}\ \cancel{mol\ NaOH} \times \frac{1\ mol\ H_2C_2O_4}{2\ \cancel{mol\ NaOH}} = 0.00813_{45}\ mol\ H_2C_2O_4$$

How many grams is this?

$$0.00813_{45}\ \cancel{mol\ H_2C_2O_4} \times \frac{90.035g\ H_2C_2O_4}{1\ \cancel{mol\ H_2C_2O_4}} = 0.7324\ g\ H_2C_2O_4$$

What is the percent oxalic acid?

$$\frac{0.7324\ g\ H_2C_2O_4}{4.554\ g\ mixture} \times 100\% = \mathbf{16.1\ \%\ H_2C_2O_4}$$

We can combine the first three steps in one string of calculations:

$$29.58\ \cancel{mL} \times \frac{1\ \cancel{L}}{1000\ \cancel{mL}} \times \frac{0.550\ \cancel{mol\ NaOH}}{1\ \cancel{L}} \times \frac{1\ \cancel{mol\ H_2C_2O_4}}{2\ \cancel{mol\ NaOH}} \times \frac{90.035g\ H_2C_2O_4}{1\ \cancel{mol\ H_2C_2O_4}} = 0.7324\ g\ H_2C_2O_4$$