

Take-Home Assignment #8

Please turn in neatly worked solutions for the following problems by 4:00 PM on Monday, October 22nd.

1. One method for determining the amount of magnesium hydroxide in Milk of Magnesia (MOM) is to dissolve a portion in a solution of HCl. The resulting Mg^{2+} is then precipitated as MgNH_4PO_4 . After filtering, the precipitate is heated, converting it to a final form of $\text{Mg}_2\text{P}_2\text{O}_7$. The mass of $\text{Mg}_2\text{P}_2\text{O}_7$ in mg, therefore, is the analytical signal. When a 2.00-mL portion of a sample containing 400.0 mg $\text{Mg}(\text{OH})_2$ per 5.00 mL is treated in this manner, 305.3 mg of $\text{Mg}_2\text{P}_2\text{O}_7$ are obtained. What is the value of k_{Mg} for this analysis? Treat all concentrations in ppm.
2. A potential interferent in this analysis is Zn^{2+} , which will precipitate as ZnNH_4PO_4 and be isolated as $\text{Zn}_2\text{P}_2\text{O}_7$. In a separate analysis, a 2.00-mL sample containing 400.0 mg $\text{Mg}(\text{OH})_2$ and 100.0 mg $\text{Zn}(\text{OH})_2$ per 5.00 mL yields a precipitate of 366.6 mg. What is the value of k_{Zn} and the selectivity coefficient, $K_{\text{Mg}/\text{Zn}}$? Is this method more sensitive to $\text{Zn}(\text{OH})_2$ or $\text{Mg}(\text{OH})_2$? Briefly explain. Treat all concentrations in ppm.
3. Suppose you wish to use this method to find the amount of $\text{Mg}(\text{OH})_2$ in MOM. What is the maximum concentration ratio ($[\text{Zn}(\text{OH})_2]/[\text{Mg}(\text{OH})_2]$) that can be tolerated if the determinate error is to be less than $\pm 1\%$? Treat all concentrations in ppm.
4. One method for effecting a separation of Mg^{2+} and Zn^{2+} , after dissolving the $\text{Mg}(\text{OH})_2$ and $\text{Zn}(\text{OH})_2$ in acid, is to complex the Zn^{2+} with EDTA (a very strong ligand). To evaluate the utility of this method a 2.00-mL sample containing 400.0 mg $\text{Mg}(\text{OH})_2$ per 5.00 mL was analyzed both without adding EDTA and after adding EDTA, giving 304.8 mg and 297.8 mg of $\text{Mg}_2\text{P}_2\text{O}_7$, respectively. What is the % recovery for $\text{Mg}(\text{OH})_2$? When this was repeated with a 2.00-mL sample containing 100.0 mg $\text{Zn}(\text{OH})_2$ per 5.00 mL, precipitates of 61.09 mg and 2.45 mg $\text{Zn}_2\text{P}_2\text{O}_7$ were obtained, respectively. What is the % recovery for $\text{Zn}(\text{OH})_2$? Treat all concentrations in ppm.
5. Suppose you have a sample containing 400.0 mg $\text{Mg}(\text{OH})_2$ per 5.00 mL and 100.0 mg $\text{Zn}(\text{OH})_2$ per 5.00 mL and that you use EDTA to effect a separation between $\text{Mg}(\text{OH})_2$ and $\text{Zn}(\text{OH})_2$. Based on your results for question 4, what percent error do you expect for the analysis? Treat all concentrations in ppm.