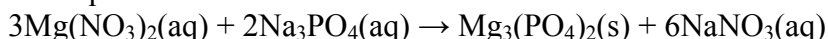


Investigation 7.B: Determining the Concentration of a Solution Answer Key

Answers to Analysis Questions

1. Show all calculations clearly.

- (a) Suppose you were given a volume of 50.0 mL of 0.150 mol/L $\text{Mg}(\text{NO}_3)_2(\text{aq})$, and you decided to use sodium phosphate, $\text{Na}_3\text{PO}_4(\text{aq})$, to precipitate the magnesium from solution. The equation is:



If you obtained 0.62 g of $\text{Mg}_3(\text{PO}_4)_2(\text{s})$ by filtration, the calculation is as follows:

$$m = 0.62 \text{ g } \text{Mg}_3(\text{PO}_4)_2 \times \frac{1 \text{ mol } \text{Mg}_3(\text{PO}_4)_2}{262.87 \text{ g } \text{Mg}_3(\text{PO}_4)_2} \times \frac{3 \text{ mol } \text{Mg}(\text{NO}_3)_2}{1 \text{ mol } \text{Mg}_3(\text{PO}_4)_2} \times \frac{148.31 \text{ g } \text{Mg}(\text{NO}_3)_2}{1 \text{ mol } \text{Mg}(\text{NO}_3)_2}$$

$$m = 1.0 \text{ g } \text{Mg}(\text{NO}_3)_2(\text{aq})$$

This represents the mass of solute dissolved in 50.0 mL of the original solution.

- (b) Continuing with the same data as above, the mass of solute per 100 mL of solution is $2 \times 1.0 \text{ g} = 2.0 \text{ g}$.
- (c) Using the same data as above, you should calculate the molar concentration in the following way:

$$c = 0.62 \text{ g } \text{Mg}_3(\text{PO}_4)_2 \times \frac{1 \text{ mol } \text{Mg}_3(\text{PO}_4)_2}{262.87 \text{ g } \text{Mg}_3(\text{PO}_4)_2} \times \frac{3 \text{ mol } \text{Mg}(\text{NO}_3)_2}{1 \text{ mol } \text{Mg}_3(\text{PO}_4)_2} \times \frac{1000 \text{ mL}}{L} \times \frac{1}{50.0 \text{ mL}}$$

$$c = 0.14 \frac{\text{mol}}{\text{L}} \text{Mg}(\text{NO}_3)_2(\text{aq})$$

If the expected concentration is 0.150 mol/L, this is a reasonable result considering that some of the magnesium phosphate will remain dissolved in solution.

2. Errors could include the following:

- The solubility of expected precipitate is close to the 0.1 mol/L limit and less precipitate is obtained than expected, because the combined volume of the filtrate and washings dissolved precipitate significantly. This is especially true for the $\text{CaSO}_4(\text{s})$, which has the highest K_{sp} of the salts suggested—you need to consider this qualitatively, not quantitatively.
- The sample is insufficiently dry and the mass obtained exceeds what should be expected, resulting in a higher than expected concentration for the original solution concentration.
- Milky filtrate or damaged filter paper could give a low result.
- Failing to add sufficient reactant to produce maximum precipitate would give a low result.

3. Improvements could include drying for a longer period of time, refiltering the filtrate if it is milky, using a smaller pore filter paper, or adding more reactant to ensure maximum precipitation.

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ANSWER KEY		

4. A milky filtrate is an example of evidence that not all of the precipitate was collected on the filter paper. This would result in an underestimation of the mass of precipitate, which would cause the calculated concentration of the $\text{Mg}(\text{NO}_3)_2$ solution to be too low.

Answer to Conclusion Question

5. You should report your data with the appropriate number of significant digits. Using the data in the answer to Analysis Question 1, the concentration of the solution is $0.14 \text{ mol/L Mg}(\text{NO}_3)_2(\text{aq})$.