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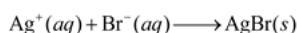
Problem

A 0.9157-g mixture of CaBr₂ and NaBr is dissolved in water, and AgNO₃ is added to the solution to form AgBr precipitate. If the mass of the precipitate is 1.6930 g, what is the percent by mass of NaBr in the original mixture?

Step-by-step solution

Step 1 of 3

Write the molecular and precipitation equation of the given reaction.



First, we need to find out the number of moles of Br⁻ in the solution mixture of NaBr and CaBr₂. In this problem, the relative amounts of NaBr and CaBr₂ are not given. But, we can calculate the total amount of Br⁻ ions in the mixture from the amount of AgBr produced.

$$\text{Moles} = \frac{\text{Weight of AgBr}}{\text{Molecular weight of AgBr}} \times \text{Mole ratio}$$

$$\begin{aligned} \text{Moles of Br}^- &= 1.6930 \text{ g AgBr} \times \frac{1 \text{ mol AgBr}}{187.8 \text{ g AgBr}} \times \frac{1 \text{ mol Br}^-}{1 \text{ mol AgBr}} \\ &= \boxed{9.0149 \times 10^{-3} \text{ mol Br}^-} \end{aligned}$$

[Comment](#)

Step 2 of 3

The total amount of Br⁻ comes from the amount of NaBr and CaBr₂. We need to calculate the number of moles of NaBr and CaBr₂ reacted with AgNO₃ from the amount of AgBr produced.

Let us consider x be the number of moles of NaBr. Then the number of moles of CaBr₂ = $9.0149 \times 10^{-3} \text{ mol} - x/2$. The moles of CaBr₂ are divided by two, because 1 mole of CaBr₂ produces 2 moles of Br⁻. The sum of the masses of NaBr and CaBr₂ is equal to the total mass of the mixture.

Mass of NaBr + Mass of CaBr₂ = Mass of Mixture = 0.9157 g.

Mass of XBr = Moles of XBr × Molecular weight of XBr Where X = Na or Ca

$$\left[x \text{ mol NaBr} \times \frac{102.89 \text{ g NaBr}}{1 \text{ mol NaBr}} \right] + \left[\left(\frac{9.0149 \times 10^{-3} - x}{2} \right) \text{ mol CaBr}_2 \times \frac{199.88 \text{ g CaBr}_2}{1 \text{ mol CaBr}_2} \right] = 0.9157 \text{ g}$$

$$102.89x + \left(\frac{0.0090149 \times 199.88}{2} \right) - \frac{199.88x}{2} = 0.9157$$

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$$x = 5.0169 \times 10^{-3} \text{ mol NaBr}$$

Chapter 9, Problem 142AP

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Converting moles to grams:

$$\begin{aligned} \text{Mass of NaBr} &= \text{Moles of NaBr} \times \text{Molecular weight of NaBr} \\ &= 5.0169 \times 10^{-3} \text{ mol NaBr} \times 102.89 \text{ g/mol NaBr} \\ &= 0.5162 \text{ g NaBr} \end{aligned}$$

From the mass of NaBr, we can calculate the percentage mass of NaBr in the given mixture.

$$\begin{aligned} \% \text{ NaBr} &= \frac{\text{Weight of NaBr}}{\text{Total weight of the mixture}} \times 100\% \\ &= \frac{0.5162 \text{ g}}{0.9157 \text{ g}} \times 100\% \\ &= 56.37\% \text{ NaBr} \end{aligned}$$

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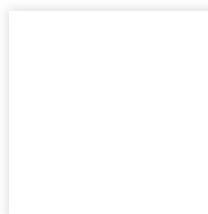
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