Problem

A common chemical demonstration involves the reaction of silver(I) nitrate and sodium chloride to produce sodium nitrate and solid silver(I) chloride. Assuming that silver(I) nitrate costs $2.27 per gram, calculate the mass in grams of silver(I) nitrate required to produce 8.00 grams of silver(I) chloride in the demonstration. Then calculate the cost (to the nearest dollar) of the silver(I) nitrate.

Solution

*This is a simple stoichiometry problem, and you are asked to calculate the amount of a reactant required to produce a given amount of product. To begin the problem, write a balanced chemical equation describing the demonstration. You have already been told the reactants and products of the reaction, so you merely need to write out the equation and balance it.*

$$AgNO_3 + NaCl \rightarrow NaNO_3 + AgCl$$

*You will also need to calculate the formula weights of the two compounds involved in the calculation - $AgNO_3$ and AgCl. You don't need to calculate formulas weights for the other two compounds.*

$AgNO_3$

| ***Element*** | ***Number of atoms*** | ***Atomic weight (g/mol)*** | ***Sum (g/mol)*** |
|---|---|---|---|
| Ag | 1 | 107.87 | 107.87 |
| N | 1 | 14.01 | 14.01 |
| O | 3 | 16.00 | 48.00 |
| Grand total → | | | **169.88** |

AgCl

| ***Element*** | ***Number of atoms*** | ***Atomic weight (g/mol)*** | ***Sum (g/mol)*** |
|---|---|---|---|
| Ag | 1 | 107.87 | 107.87 |
| Cl | 1 | 35.45 | 35.45 |
| Grand total → | | | **143.32** |

*Now, solve the problem using dimensional analysis.*

$$8.00\,\text{g AgCl} \times \frac{\text{mol AgCl}}{143.32\,\text{g AgCl}} \times \frac{1\,\text{mol AgNO}_3}{1\,\text{mol AgCl}} \times \frac{169.88\,\text{g AgNO}_3}{\text{mol AgNO}_3} = 9.48\,\text{g AgNO}_3$$

*The demonstration requires **9.48 grams** of silver(I) nitrate, which would cost **$22** (rounded to the nearest dollar).*