Stoichiometry – Limiting Reactant Example Problem Solution

Solutions of sodium carbonate and silver (I) nitrate react to form solid silver (I) carbonate and a solution of sodium nitrate.

a) Write and balance the chemical equation of the reaction that occurs.

b) A solution containing 25.0 g of sodium carbonate is mixed with one containing 25.0 g of silver (I) nitrate. How many grams of sodium carbonate, silver (I) nitrate, silver (I) carbonate, and of sodium nitrate are present when the reaction is complete?

Note: Use AMs with at least 1 decimal for this problem.

MM:	106.0		169.9		275.8		85.0
	$Na_2CO_{3(aq)}$	+	$2AgNO_{3(aq)}$	$\longrightarrow$	$Ag_2CO_{3(s)}$	+	$2NaNO_{3(aq)}$
Moles:	1		2		1		2
Mass:	106.0g		339.8g		275.8g		170.0g

Initial moles present:

$$25.0\text{ g } Na_2CO_3 \times \frac{1\text{ mol}}{106.0\text{ g}} = 0.236\text{ mol } Na_2CO_3$$

$$25.0\text{ g } AgNO_3 \times \frac{1\text{ mol}}{169.9\text{ g}} = 0.147\text{ mol } AgNO_3$$

Then the initial stoichiometric amounts are:

For Na_2CO_3

$$\frac{0.236}{1} = 0.236$$

For $AgNO_3$

$$\frac{0.147}{2} = 0.0735$$

So, the limiting reactant is $AgNO_3$ This means that all of the initial $AgNO_3$ will be consumed in the reaction, and all other substances will react in their stoichiometric ratios:

$$25.0\text{ g } AgNO_3 \times \frac{106.0\text{ g } Na_2CO_3}{339.8\text{ g } AgNO_3} = 7.80\text{ g } Na_2CO_3 \text{ are consumed}$$

$$25.0\text{ g } AgNO_3 \times \frac{275.8\text{ g } Ag_2CO_3}{339.8\text{ g } AgNO_3} = 20.3\text{ g } Ag_2CO_3 \text{ are produced}$$

$$25.0\text{ g } AgNO_3 \times \frac{170.0\text{ g } NaNO_3}{339.8\text{ g } AgNO_3} = 12.5\text{ g } NaNO_3 \text{ are produced}$$

Then, the ICE table:

	$Na_2CO_{3(aq)}$ +	$2AgNO_{3(aq)}$ $\longrightarrow$	$Ag_2CO_{3(s)}$ +	$2NaNO_{3(aq)}$
Initial	25.0 g	25.0 g	0	0
Change	-7.8 g	-25.0 g	+20.3 g	+12.5 g
End	17.2 g	0.0 g	20.3 g	12.5 g

Note that initial mass: 25.0 g + 25.0 g = 50.0 g

Final mass: 17.2 g + 20.3 g + 12.5 g = 50.0 g