

Vonderbrink Experiment 3: Gravimetric Analysis of a Metal Carbonate

Prelab Key

An unknown metal carbonate was analyzed gravimetrically and yielded the following data:

Mass of crucible + M_2CO_3	12.627 g
Mass of crucible	10.655 g
Mass of M_2CO_3	1.972 g
Mass of filter paper + $CaCO_3$	2.436 g
Mass of filter paper	0.598 g
Mass of $CaCO_3$	1.838 g

1. From the mass of $CaCO_3$, calculate the moles of $CaCO_3$ produced.

$$? \text{ mol } CaCO_3 = 1.838 \text{ g } CaCO_3 \times \frac{1 \text{ mol } CaCO_3}{100.09 \text{ g } CaCO_3} = 1.836 \times 10^{-2} \text{ mol } CaCO_3$$

2. Calculate the molar mass of the unknown.

$$\mathcal{M} = \frac{1.972 \text{ g } M_2CO_3}{0.01836 \text{ mol } CaCO_3} \times \frac{1 \text{ mol } CaCO_3}{1 \text{ mol } M_2CO_3} = 107.4 \text{ g/mol}$$

3. Calculate the molar mass of the following Group 1 metal carbonates:

a. Li_2CO_3 : $\mathcal{M} = 2(6.94 \text{ g/mol}) + 12.01 \text{ g/mol} + 3(16.00 \text{ g/mol}) = 73.89 \text{ g/mol}$

b. Na_2CO_3 : $\mathcal{M} = 2(22.99 \text{ g/mol}) + 12.01 \text{ g/mol} + 3(16.00 \text{ g/mol}) = 105.99 \text{ g/mol}$

c. K_2CO_3 : $\mathcal{M} = 2(39.10 \text{ g/mol}) + 12.01 \text{ g/mol} + 3(16.00 \text{ g/mol}) = 138.21 \text{ g/mol}$

4. What is the identity of M_2CO_3 ?

Since the calculated molar mass is closest to 105.99 g/mol, it must be Na_2CO_3 .

5. Calculate the percent error in the molar mass determination of M_2CO_3 by comparing the experimentally determined molar mass of M_2CO_3 to the known molar mass of the appropriate metal carbonate.

$$\% \text{ error} = \frac{|107.4 \text{ g/mol} - 105.99 \text{ g/mol}|}{105.99 \text{ g/mol}} \times 100\% = \frac{1.4}{105.99} \times 100\% = 1.3\%$$