Writing and Balancing (by Inspection) Chemical Equations

Decomposition

$(NH_4)_2Cr_2O_7(s) \xrightarrow{\Delta} Cr_2O_3(s) + N_2(g) + 4H_2O(g)$

Polyatomic ions

$Na_2SO_4(aq) + Pb(NO_3)_2(aq) \longrightarrow PbSO_4(s) + 2NaNO_3(aq)$

Decomposition of $NaHCO_3$ (s)

A 1.00 g sample of $NaHCO_3$ (s) is to be heated in an open container. It decomposes to form Na_2CO_3 (s), H_2O (g) and CO_2 (g).

a. Write the balanced, completely annotated chemical equation for the reaction.

$2NaHCO_3(s) \xrightarrow{\Delta} Na_2CO_3(s) + CO_2(g) + H_2O(g)$

b. What should be the mass lost after 1.00 g of $NaHCO_3$ (s) is completely decomposed?

i. Find moles of $NaHCO_3$ (s) (84.01 g/mol) present initially

$1g \cdot \frac{1\,mol}{84.01\,g} = 0.0119\,mol$

Decomposition of $NaHCO_3$ (s)

ii. Find moles of CO_2 (g) produced.

$0.0119\ mol \cdot \frac{1\ CO_2}{2\ NaHCO_3} = 0.005952\ mol$

iii. Find moles H_2O (g) produced.

$0.0119\ mol \cdot \frac{1\ H_2O}{2\ NaHCO_3} = 0.005952\ mol$

iv. Find mass (g) of CO_2 (g) (44.01 g/mol) produced.

$0.005952\ mol \cdot \frac{44.01\ g}{1\ mol} = 0.2619\ g$

v. Find mass (g) H_2O (g) (18.01 g/mol) produced.

$0.005952\ mol \cdot \frac{18.01\ g}{1\ mol} = 0.1072\ g$

vi. Total mass lost =

$0.2619 + 0.1072 = 0.3691\ g$

Decomposition of $NaHCO_3$ (s)

A sample containing $NaHCO_3$ (s) was heated in an open container. The mass lost from the system was 0.30 g. Calculate the mass of $NaHCO_3$ (s) that decomposed.

a. Relate mass to moles.

$0.3\ g = mol\ CO_2 \cdot \frac{44.01\ g}{1\ mol} + mol\ H_2O \cdot \frac{18.01\ g}{1\ mol} = x(44.01 + 18.01)$

b. Calculate the number of moles of CO_2 (g) and H_2O (g) produced.

$x = \frac{0.3}{44.01 + 18.01} = 0.004837\ mol$

c. Calculate the mass (g) of $NaHCO_3$ (s) that reacted.

$0.004837 \cdot \frac{2\ NaHCO_3}{1\ CO_2} \cdot \frac{84.01\ g}{1\ mol} = 0.8127\ g$