Teacher's Tools® Chemistry

Chemical Reactions : Combustion and Decomposition Reactions: Student Review Notes

Combustion Reactions

Combustion means that you burn something. Look for "burned" in the reaction statement. An atom of molecule can be burnt in oxygen or nitrogen. Remember that air is a mixture of oxygen and nitrogen (79% N_2 and 21% O_2). The most stable oxides and/or nitrides are the products of a combustion reaction. The nitrides are typically only included for the combustion of metals. Read the reaction statements carefully, they will often say "in air," "in oxygen," or "in nitrogen."

Combustion reactions are a class of redox reactions.

Take a look at these examples (not balanced):

Hydrogen is burned in air: $H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(g)}$ (not necessary to include nitrogen)

Ethanol is burned in air: $C_4H_5OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$ (not necessary to include nitrogen)

Methane is burned in air: $CH_{4(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$ (not necessary to include nitrogen)

Sulfur is burned in oxygen: $S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$

Magnesium is burned in nitrogen: $Mg_{(s)} + N_{2(g)} \rightarrow Mg_3N_{2(s)}$

Magnesium is burned in oxygen: $Mg_{(s)} + O_{2(g)} \rightarrow MgO_{(s)}$

Magnesium is burned in air: $Mg_{(s)} + O_{2(g)} + N_{2(g)} \rightarrow MgO_{(s)} + Mg_3N_{2(s)}$ (it's a metal, include nitrogen)

Decomposition Reactions

A decomposition reaction is the breakdown of a compound into two or more components. Look for "heated" in the reaction statement as the tip-off for a decomposition reaction.

Decomposition reactions are a class of redox reactions.

Metal Oxides: Metal oxides decompose to yield a metal and oxygen.

For example: $MgO_{(s)} \rightarrow Mg_{(s)} + O_{2(g)}$

Metal Carbonates: Metal carbonates decompose a metal oxide and carbon dioxide.

For example: $MgCO_{3(s)} \rightarrow MgO_{(s)} + CO_{2(g)}$

Metal Bicarbonates: Metal bicarbonates decompose a metal oxide, carbon dioxide and water.

For example: $CaHCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)} + H_2O_{(g)}$

Metal Nitrates: Metal nitrates decompose a metal oxide, nitrogen dioxide and oxygen.

For example: $Cu(NO_3)_{(s)} \rightarrow CuO_{(s)} + NO_{2(g)} + O_{2(g)}$

Metal Sulfates: Metal sulfates decompose a metal oxide and sulfur trioxide

For example: $Na_2SO_{4(s)} \rightarrow Na_2O_{(s)} + SO_{3(g)}$

Metal Sulfites: Metal sulfites decompose a metal oxide and sulfur dioxide

For example: $Na_2SO_{3(s)} \rightarrow Na_2O_{(s)} + SO_{2(g)}$