

# Extra Test Review

**Percent Composition.** Percentage composition is determined by finding the formula mass of a compound, multiplying the mass of each element by 100, and dividing the product by the formula mass of the compound. Use the periodic table to find the masses of individual elements. See the **Sample Problem** bto the right

**Chemical Equations.** Chemical equations provide a shorthand way to easily describe what occurs during a chemical reaction. In a typical chemical equation, the reactants are written on the left, while the products are written on the right. The reactants and products are separated by an arrow, or yield sign, which indicates that reactants yield products. ( **REACTANTS** → **PRODUCTS** )

There are other symbols as well that show the state of the chemicals involved in the reaction. They are: (s) or ↓ for a solid precipitate; (l) for a liquid; (g) or ↑ for a gas; and (aq) for dissolved in water or aqueous. Symbols can also be used to show other factors involved in the reaction such as sources of energy used. These include: Δ for heat or ↑ for light. These symbols are written above or below the yield sign because they are neither reactants nor products. The complete equation shows the identity of the reactants and products using chemical formulas and symbols, the phases of the reactants and products, any energy changes involved in the reaction, and the mole ratios of all the substances indicated by the coefficients. Equations may occasionally be written omitting information about phases or energy changes. The example below shows a complete chemical equation with all the components.

The equation shows that the reactant is solid potassium chlorate, the products are solid potassium chloride and oxygen gas, manganese dioxide is a catalyst, and the reaction is endothermic. Symbols for manganese dioxide and heat are shown above and below the yield sign because they are neither reactants nor products.

**Reaction Types.** Chemical reactions can be grouped into four basic types. They are direct combination or synthesis, decomposition, single replacement or substitution, and double replacement or exchange of ions.

An example of **synthesis** is shown below: Synthesis often results in the formation of only one product from two reactants, but not always.

Combustion, as in the following example,  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}$ , is also a form of synthesis because the oxygen combines with both the metal and the nonmetal to form two oxides.

**Decomposition** is the reverse of synthesis. One reactant breaks apart to form several products. This is what happens when hydrogen peroxide decomposes over time to leave behind plain, ordinary water [ $2\text{H}_2\text{O}_2(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$ ].

During a **single replacement** reaction, a more active metal replaces a less active metal in a compound, or a more active nonmetal replaces a less active nonmetal in a compound. This is what happens when a metal becomes corroded by an acid [ $2\text{Fe}(\text{s}) + 6\text{HCl}(\text{aq}) \rightarrow 2\text{FeCl}_3(\text{aq}) + 3\text{H}_2(\text{g})$ ]. In single replacement reactions, an element is reacting with a compound.

**Double replacement** reactions occur between aqueous compounds. The cations and anions switch partners. If an insoluble precipitate forms, the reaction is an end reaction, otherwise the result is an aqueous mixture of ions. An example of a double replacement reaction is  $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{AgCl}(\text{s})$ .

*Sample Problem:* Find the percentage composition of  $\text{MgCO}_3$ .

Formula Mass	Percentage Composition
Mg = $24 \times 1 = 24$	% Mg = $24 \times 100 \div 84 = 29$
C = $12 \times 1 = 12$	% C = $12 \times 100 \div 84 = 14$
O = $16 \times 3 = 48$	% O = $48 \times 100 \div 84 = 57$
84	100

## Patterns of the Reaction Types

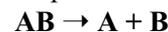
### Legend:

- ▶ A and C = *metals*
  - ▶ B and D = *nonmetals*
- ◆ —

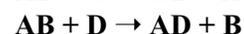
Direct combination (synthesis)



Decomposition



Single Replacement (substitution)



Double Replacement (Exchange of Ions)



