

The most common types of chemical reactions

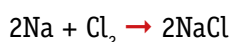
All chemical reactions can be placed into general categories. The following are the most common types of chemical reactions:

➤ Combination (or synthesis) reactions

In combination reactions two or more substances combine to form a more complicated one. The chemical equation for this reaction is



An example of a combination reaction is sodium combining with chlorine to form sodium chloride:



➤ Decomposition reactions

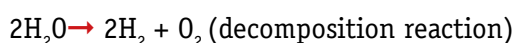
In a decomposition reaction a more complex substance breaks down to make simpler ones. The chemical equation for decomposition reactions is



An example is the decomposition reaction of calcium carbonate forming calcium oxide and carbon dioxide:



Decomposition reactions are the opposite of combination reactions, so hydrogen and oxygen form water in a combination reaction, and water can be broken down into hydrogen gas and oxygen gas in a decomposition reaction:



➤ Single displacement reactions

A single displacement reaction occurs when a more active element takes the place of another less active element in a compound. The general form of the equation is



For example zinc combines with hydrochloric acid replacing hydrogen and forming zinc chloride:



➤ Double displacement reactions

In a double displacement reaction parts of two compounds switch places to form two new compounds. The equation that shows a double displacement reaction is



For example when silver nitrate reacts with

sodium chloride, sodium and silver switch their places so that sodium nitrate and silver chloride are formed:



Double displacement reactions usually occur in a solution, forming either an insoluble solid (in **precipitation** reactions) or water (in neutralization reactions).

Precipitation in chemistry is the formation of an insoluble solid in a solution. The solid formed is called the precipitate, while the liquid remaining above the solid is called the supernate.

➤ Combustion reactions

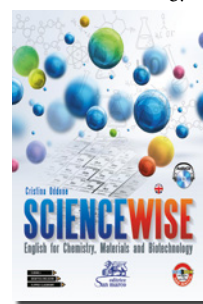
A combustion reaction occurs when a compound, usually containing carbon, combines with oxygen yielding water and carbon dioxide. This type of process is commonly called *burning* and heat is a useful product of most combustion reactions. This form of energy is used to heat homes and buildings, to drive cars, lorries, ships, airplanes, trains, to operate industrial processes and for several other uses. An example of combustion reactions is the reaction of **gasoline** with oxygen:



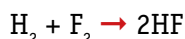
Gasoline, which is called *petrol* in British English, is a liquid mixture made from crude oil, which is pumped out of the ground in the form of a black liquid. Gasoline (or gas) is used as a fuel, but it can have other uses (for example as a solvent). Gasoline, produced in oil refineries, is a vital fluid in all the industrialized world. The USA alone consumes almost 500 billion litres of gasoline per year.

➤ Redox reactions

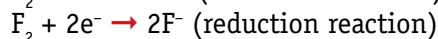
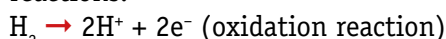
A redox reaction occurs when electrons are exchanged between the reactants. The term "redox" comes from the two concepts of *reduction* and *oxidation*. Reduction occurs when a reactant gains electrons, while oxidation occurs when a reactant loses electrons. Therefore, a process in which an element loses electrons during a chemical reaction is called oxidation, whereas a process in which an element gains electrons during a chemical reaction is called reduction. The reactant losing



electrons is oxidized and the reactant gaining electrons is reduced. An example of redox reactions is



Here hydrogen is oxidized and fluorine is reduced. This reaction can be written as two half reactions:



Other types of reactions can be at the same time also redox reactions, because they in-

volve the transfer of electrons, for example the combination reaction forming sodium chloride $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$, and the burning of coal (which is nearly pure carbon) $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$. Oxidation – reduction reactions are vital for biochemical reactions and industrial processes. Redox reactions are involved in combustion, rusting¹, photosynthesis, respiration; they are also fundamental to produce batteries, to convert ammonia into nitric acid for fertilisers, and to coat² compact discs.

GLOSSARY

- 1 the formation of reddish-brown ferric oxides (rust) on iron and iron-containing materials in the presence of water
- 2 to cover with a layer of material

ACTIVITIES

1 Write the chemical equation for the following types of chemical reactions.

- 1 Combination reaction
.....
- 2 Decomposition reaction
.....
- 3 Single displacement reaction
.....
- 4 Double displacement reaction
.....

2 Write the type of chemical reaction corresponding to each definition given below.

- 1 A compound combines with oxygen yielding water and carbon dioxide
- 2 A more complex substance breaks down to make simpler ones
- 3 Electrons are exchanged between the reactants
- 4 Two or more substances combine to form a more complicated one
- 5 Parts of two compounds switch places to form two new compounds
- 6 A more active element takes the place of another less active element

3 Match the following chemical formulae to the corresponding compound.

- | | |
|------------------------------|---------------------|
| 1 NaCl | A Calcium oxide |
| 2 CaCO_3 | B Gasoline |
| 3 CaO | C Sodium chloride |
| 4 CO_2 | D Silver chloride |
| 5 HCl | E Hydrochloric acid |
| 6 ZnCl_2 | F Calcium carbonate |
| 7 AgNO_3 | G Carbon dioxide |
| 8 AgCl | H Silver nitrate |
| 9 NaNO_3 | I Zinc chloride |
| 10 C_8H_{18} | J Sodium nitrate |

4 Find in the text synonyms for the following words.

- | | |
|--------------------|-------|
| 1 Class | ..... |
| 2 To join together | ..... |
| 3 To decompose | ..... |
| 4 To exchange | ..... |
| 5 To take place | ..... |
| 6 Combustion | ..... |
| 7 Truck | ..... |
| 8 To obtain | ..... |
| 9 To implicate | ..... |
| 10 Essential | ..... |