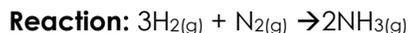


# Ten Important Chemical Reactions

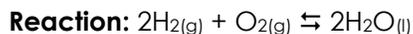
## 1. Synthesis of ammonia.



Hydrogen gas and nitrogen gas are combined in the presence of a catalyst at high temperature and pressure to produce ammonia gas.

**Significance:** Synthesis of ammonia leads to the production of fertilizer (ammonium nitrate) and to the production of ammunitions.

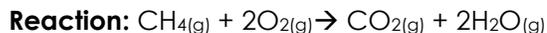
## 2. Combustion of hydrogen / Electrolysis of water



Hydrogen gas and oxygen combine to produce liquid water.

**Significance:** In the forward direction this is a spontaneous reaction that explosively oxidized hydrogen to water. It has a high activation energy but once started it is very exothermic. Hydrogen is a fuel. In the reverse direction this reaction is non-spontaneous. Electricity can be used to "split" water into hydrogen and oxygen. This is the basis of the fuel cells in the hydrogen powered vehicle.

## 3. Combustion of methane (hydrocarbons)



Methane gas and oxygen gas combine exothermically to produce carbon dioxide gas and water vapor.

**Significance:** Methane is the simplest of the hydrocarbons, all of which combine with oxygen and undergo oxidation. If the oxidation is complete the products are carbon dioxide (a greenhouse gas) and water. Incomplete combustion will produce carbon monoxide and carbon (soot). Methane is obtained from underground and is from the decomposition of prehistoric plants and other organic matter. Fossil fuels are burned (oxidized) to produce heat and provide energy for many machines and for cooking and heating. There are serious concerns currently about the rapid increase of carbon dioxide in our atmosphere.

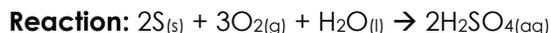
## 4. Photosynthesis



Carbon dioxide and water combine in the presence of sunlight (and many biologically catalyzed reactions) to produce oxygen and glucose (sugar).

**Significance:** Our atmosphere is 21% oxygen - in spite of the tendency of oxygen to react with so many substances. The constant level of oxygen is maintained by the many plants that inhabit our planet through the reaction of photosynthesis. This is truly solar energy at its most efficient and productive!

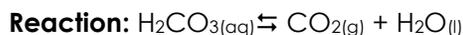
## 5. Synthesis of sulfuric acid



Sulfur is first oxidized to sulfur dioxide and then to sulfur trioxide. This gas is bubbled through water to produce sulfuric acid. There are other methods to synthesize this substance.

**Significance:** Sulfuric acid is a very important chemical and an indicator of a nation's industrial strength. World production in 2004 was about 180 million tonnes. Most of this amount (~60%) is consumed for fertilizers, particularly superphosphates, ammonium phosphate and ammonium sulfates. Sulfuric acid is needed to dissolve very insoluble phosphate ores.

## 6. Equilibrium of carbonic acid and carbon dioxide gas.



Carbonic acid breaks down to produce carbon dioxide gas and liquid water.

**Significance:** Carbon dioxide dissolves in water to an extent determined by temperature and pressure. When this occurs carbonic acid is formed which lowers the pH of the water. Soda pop is a carbonated drink - the acid counterbalances the added sugars and gives the drink its fizzy quality. As more carbon dioxide builds up in our atmosphere the pH of the ocean is decreasing and the ocean "sinks" this carbon dioxide (dissolves it).

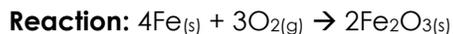
## 7. Biological formation of calcium carbonate.



Calcium ions combine with carbonate ions to produce insoluble calcium carbonate.

**Significance:** Many sea creatures produce shells. Birds and reptiles produce eggs with shells. All of these shells are composed of calcium carbonate. Over time these shells collect, are buried, and produce limestone. If limestone is subjected to heat and pressure it may undergo metamorphoses into marble.

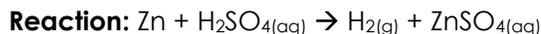
## 8. Rusting of iron.



Iron metal combines with oxygen gas to produce iron (III) oxide.

**Significance:** Iron is the main ingredient of steel, an alloy used in many structures. As oxygen attacks iron it converts it to one of its oxides, iron (III) oxide as shown here or iron(II) oxide or some combination of the two. Rust varies in color from red to yellow but it should be noted that it does not stick to iron. It flakes off continuously exposing more iron to oxygen. Finding ways to stop iron from rusting has led to longer lasting structures.

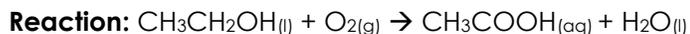
## 9. Production of hydrogen from the action of acid on metal.



Zinc combined with sulfuric acid produces hydrogen gas and soluble zinc sulfate.

**Significance:** One way of synthesizing some hydrogen gas for use in the laboratory is to liberate it from an acid using an active metal. Zinc works well for this purpose.

## 10. Oxidation of alcohol.



Ethyl alcohol and oxygen produce acetic acid and water.

**Significance:** Wine becomes sour with age and exposure to the air. This is due to the conversion of alcohol to acetic acid (vinegar).