Air Pollutants

Fuel Combustion

1. **Fuel combustion produces pollutants:** Alongside contributing to global climate change, fuel combustion produces **pollutants**. The pollutants vary depending on the type of fuel that is combusted.
2. **Many fuels contain carbon. Carbon** is found in many fuels, as is hydrogen. Some fuels also contain sulphur. These all contribute to the pollutants produced when fuels are combusted.

Release of Atmospheric Pollutants

1. **Carbon dioxide and water vapour are produced from burning fuels**. When fuels are **burnt**, carbon dioxide and water vapour are pollutants that are formed from complete combustion.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

2. **Carbon monoxide can be produced from burning fuels**. **Carbon monoxide** can also be formed from incomplete combustion of fossil fuels.
3. **Sulphur dioxide can be formed from burning fuels.** As well as carbon products, **sulphur dioxide** can be formed when fuels are combusted. Small amount of sulphur is present in coal. Sulphur dioxide is formed when coal is burnt.
4. **Nitrogen oxides can be formed from burning fuels.** Nitrogen does not react with oxygen at room temperature. However, in a car or aeroplane engine, temperatures reach well over 1000°C. This exceeds the activation energy of the reaction and nitrogen burns in the oxygen at these high temperatures, to make **nitrogen oxides**.

Products of Fuel Combustion

1. **Oxygen allows complete combustion to occur.** When oxygen is present in a reaction, complete combustion can occur. This means that all the reactants will be **completely combusted** into carbon dioxide and water.
2. **In reduced oxygen, incomplete combustion occurs.** When there is insufficient oxygen in a reaction, **incomplete combustion** will occur. This means that the reactants will not be completely combusted, producing carbon monoxide, water and some solid carbon particulates and unburnt hydrocarbons.

3. **Incomplete combustion products are harmful.** The products of incomplete combustion can be **harmful**. We will be discussing some of their effects in the next section.
4. **Sometimes sulphur dioxide is formed**. Some fossil fuels contain **sulphur impurities**, so when burned can be oxidised to form sulphur dioxide.

The Effects of Toxic Pollutants

Carbon Monoxide

1. **Carbon monoxide is a product of incomplete combustion**. Carbon monoxide is a **toxic** gas product of incomplete combustion. Its chemical formula is CO.
2. **Carbon monoxide is colourless.** Carbon monoxide is extremely difficult to detect as it is a colourless gas. It is also **odorless**.
3. **Carbon monoxide is extremely harmful.** Carbon monoxide can reduce the amount of oxygen that the body receives. A lack of oxygen means that the body can go into a **coma**, or even die.

Nitrogen Oxides

1. **Nitrogen and oxygen combine to form nitrogen monoxide**. This is often seen when fuels are burned in vehicle engines. This usually occurs at high temperatures.
2. **Nitrogen monoxide reacts with oxygen to form nitrogen dioxide**. As vehicle engines release **nitrogen monoxide**, it is combined with oxygen from the air forming nitrogen dioxide.
3. **Catalytic converters remove nitrogen oxides from car exhausts**. Catalytic converters convert nitrogen oxides into nitrogen and oxygen. They also convert carbon monoxide into carbon dioxide. This reduces the release of **atmospheric pollutants**.

Acid Rain

1. **Sulphur and nitrogen can combine with rainwater.** Sulphur dioxide and nitrogen oxides can combine with clouds and water. As they are gases, they can easily mix with **rainwater**.
2. **Acid rain is formed**. When sulphur dioxide combines with water, sulphuric acid is formed. When nitrogen oxides combine with water, nitric acid is formed. Both of these acids are dilute, due to mixing with rainwater to form **acid rain**.
3. **Acid rain causes significant damage.** Despite being dilute, acid rain can cause damage in the form of **eroding stone** buildings by reacting with limestone. It can also cause fish in rivers and lakes to die, as it is very acidic.