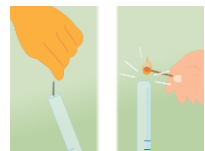


## KIP – Knowledge is power.

### Chemistry 9

#### Gas tests



The test for hydrogen uses a burning splint held at the open end of a test tube of the gas. Hydrogen burns rapidly with a squeaky pop sound.

The test for carbon dioxide uses lime water (A solution of calcium hydroxide and water). When carbon dioxide is shaken with or bubbled through limewater the limewater turns milky (cloudy).

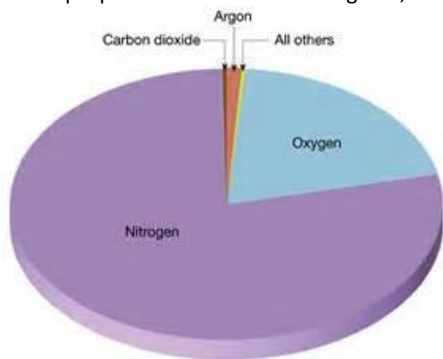


The test for **chlorine** uses litmus paper. When damp litmus paper is put into chlorine gas the litmus paper is bleached and turns white.

#### The proportions of different gases in the atmosphere

For **200 million years**, the proportions of different gases in the atmosphere have been much the same as they are today:

- about four-fifths (approximately 80%) nitrogen
- about one-fifth (approximately 20%) oxygen
- small proportions of various other gases,



#### The Earth's early atmosphere

Theories about what was in the Earth's early atmosphere and how the atmosphere was formed have changed and developed over time. Evidence for the early atmosphere is limited because of the time scale of 4.6 billion years (the age of the Earth).



One theory suggests that during the **first billion years** of the Earth's existence the Earth's atmosphere would have been like the atmospheres of **Mars and Venus** consisting mainly of **Carbon dioxide with little or no oxygen**. It is thought that there was intense **volcanic activity** that released gases that formed the early atmosphere and **water vapour** that **condensed** to form the oceans.

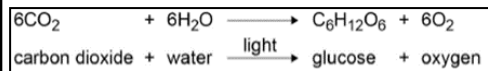
Volcanoes also produced **nitrogen** which gradually built up in the atmosphere and there may have been small proportions of **methane** and **ammonia**.

When the oceans formed **carbon dioxide dissolved** in the water, reducing the amount of carbon dioxide in the atmosphere.

Some of the carbon dioxide that dissolved in the water reacted and made **insoluble** (won't dissolve) **compounds** such as calcium carbonate (limestone). This produced sediments that fell (**precipitated**) to the sea floor. Some carbon produced compounds that became the shells and skeletons of sea creatures. When the sea creatures died these fell to the sea floor and over years became sedimentary rocks and fossil fuels (coal, crude oil and natural gas).

#### How oxygen increased

Algae and plants produced the oxygen that is now in the atmosphere by photosynthesis, which can be represented by the equation:



Algae first produced oxygen about **2.7 billion years ago** and soon after this oxygen appeared in the atmosphere. Over the next billion years plants evolved and the percentage of oxygen gradually **increased** to a level that enabled animals to evolve.

#### How carbon dioxide decreased

**Algae and plants decreased** the percentage of carbon dioxide in the atmosphere by photosynthesis.

Carbon dioxide was also decreased by the formation of **sedimentary rocks** and **fossil fuels** that contain carbon.

#### Greenhouse gases

Greenhouse gases in the atmosphere maintain temperatures on Earth high enough to support life.

**Water vapour (H<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>)** are greenhouse gases.

The **sun** gives out radiation in the forms of **ultraviolet, visible light and infrared**, most of this passes through the gases in the atmosphere and reaches Earth. The **Earth** also gives off radiation but as it is cooler it tends to give out radiation with **longer wavelengths** only in the **infrared region**. Greenhouse gases in the atmosphere can absorb these longer wavelength and keep the Earth warm.

Some **human activities** increase the amounts of greenhouse gases in the atmosphere. These include:

- **The burning of fossil fuels** increasing the levels of carbon dioxide
- **Deforestation** increases the amount of carbon dioxide.
- Methane levels are affected by **farming**. Methane is a product of normal digestion in animals.
- **Landfill** sites also add to the levels of methane and waste decomposes in them.

Based on **peer-reviewed** evidence, many scientists believe that human activities will cause the temperature of the Earth's atmosphere to increase due to the increased release of greenhouse gases. This will result in **global climate changes**.

Peer reviewed: Before scientific research is published other scientists examine the study and ensure that the results are valid.

However, it is difficult to model such complex systems as global climate change. This leads to simplified models, speculation and opinions presented in the media that may be based on only parts of the evidence and which may be biased.

#### Global climate change

An increase in average global temperature is a major cause of climate change.

- **Sea level rise:** As temperatures rise the polar ice caps melt leading to an increase in water volume. This means that some parts of the world are at risk of flooding and there could be an increase in coastal erosion.
- **Storms:** As the Earth warms and the climate changes, there may be more frequent and severe storms.
- **Rainfall:** The number of heavy rainfalls have increased in some areas but so has the number of droughts. This would lead to shortages of water for humans, plants and animals.
- **Wildlife:** Some species may migrate to different areas due to different temperatures. Such as birds from usually warmer climates migrating to England. This would affect food chains.
- **Food production:** The weather has a huge effect on crop production and might affect the ability of some areas to produce enough food due to rainfall patterns and the distribution of pest animals in an area.

#### The carbon footprint and its reduction

The carbon footprint is the total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a **product, service or event**.

The carbon footprint can be reduced by reducing emissions of **carbon dioxide** and **methane**.

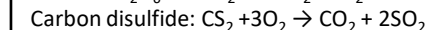
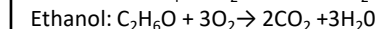
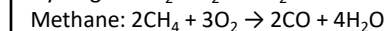
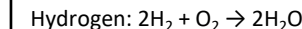
#### Atmospheric pollutants from fuels

The combustion of fuels is a major source of **atmospheric pollutants**.

Most fuels, including coal, contain **carbon** and/or **hydrogen** and may also contain some **sulfur**.

The gases released into the atmosphere when a fuel is burned may include **carbon dioxide, water vapour, carbon monoxide, sulfur dioxide and oxides of nitrogen**. Solid particles and unburned hydrocarbons may also be released that form **particulates** (soot) in the atmosphere.

Some example equations showing when fuels burn.



#### Properties and effects of atmospheric pollutants

**Carbon monoxide (CO)** is a toxic gas. It is **colourless** and **odourless** and so is not easily detected. Carbon monoxide is produced due to incomplete combustion where there is **insufficient oxygen**.

**Sulfur dioxide** and **oxides of nitrogen** cause **respiratory problems** in humans and cause **acid rain**.

**Particulates** cause **global dimming** and **health problems** for humans.