

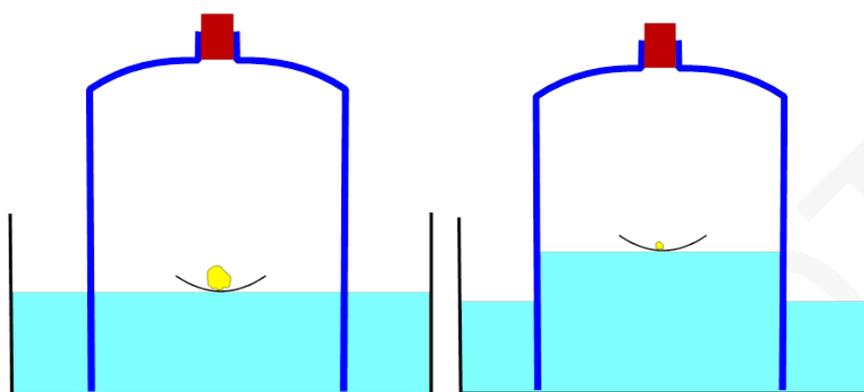
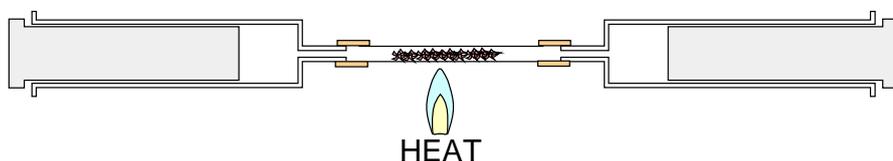
## Gases in the atmosphere

### Composition of the air

Experiments involving the reactions of elements such as copper, iron and phosphorus with air can be used to determine the percentage by volume of oxygen in air (the basic principle behind these experiments is that the substances react with the oxygen in the air and the volume of the air decreases).

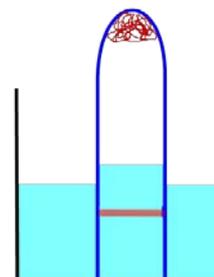
78.1 %	Nitrogen
21.0 %	Oxygen
0.9 %	Argon
0.04%	Carbon dioxide

Pass 100 cm<sup>3</sup> of air back and fore over heated copper. Copper becomes black as copper(II) oxide is formed and the volume of air (no oxygen) goes down to about 79 cm<sup>3</sup>.



Phosphorus is ignited – burns in air to form solid phosphorus oxide that dissolves in water. Level of water goes up as oxygen removed.

Place moist iron filings in a measuring cylinder – volume of air goes down (water level goes up) by 21% as oxygen is used up as iron rusts.



### Reactions of oxygen with different elements

Elements	Observations	Equations	Products
Magnesium	Bright white flame	$2\text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{MgO(s)}$	Forming white powder magnesium oxide, <b>basic</b> and slightly soluble in water. Some of it dissolves to produce a slightly alkaline solution.
Hydrogen	Blue flame	$2\text{H}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{H}_2\text{O(l)}$	
Sulphur	Bright blue flame	$\text{S(s)} + \text{O}_2\text{(g)} \rightarrow \text{SO}_2\text{(g)}$	Sulfur dioxide is an <b>acidic</b> oxide. It is soluble in water and dissolves to produce an acidic solution <b>sulfurous</b> acid $\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$

### Formation of carbon dioxide

Thermal decomposition of metal carbonates	$\text{CuCO}_3 \rightarrow \text{CuO} + \text{CO}_2$
Reaction of acid with carbonate	$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$
Complete combustion of carbon-containing substances	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

When copper(II) carbonate (green solid) is heated it decomposes to form copper(II) oxide (black solid) and carbon dioxide (colourless gas).

Carbon dioxide is a greenhouse gas – increasing amounts in the atmosphere may contribute to climate change.