

# C9 Chemistry of the atmosphere

Chemistry Paper 2 | AQA Combined Science Trilogy | Key ideas to remember

## Changing atmosphere

### 1 Air today and early Earth

**Dry air:** about 78% nitrogen, 21% oxygen and 1% other gases, mainly argon. Water vapour varies and is excluded from dry-air figures.

**Remember:** roughly four-fifths nitrogen and one-fifth oxygen. Major proportions: similar for about 200 million years. CO<sub>2</sub> can still change.

**Early atmosphere theory:** volcanic gases; much CO<sub>2</sub> and little or no oxygen. Cooling condensed water vapour into oceans. Nitrogen accumulated.

**Evidence is limited:** Earth is about 4.6 billion years old; many early rocks have changed or been destroyed.

## Greenhouse effect

### 2 Oxygen up; carbon dioxide down

**Photosynthesis:** algae and later plants take in CO<sub>2</sub> and release oxygen.

Carbon dioxide + water  
→ glucose + oxygen (**light needed**)

**CO<sub>2</sub> decreased through:**

- Dissolving in oceans.
- Photosynthesis, storing carbon in biomass.
- Carbonate sediments and shells forming **limestone**.
- Formation of **fossil fuels**.

**Coal:** ancient plant remains.

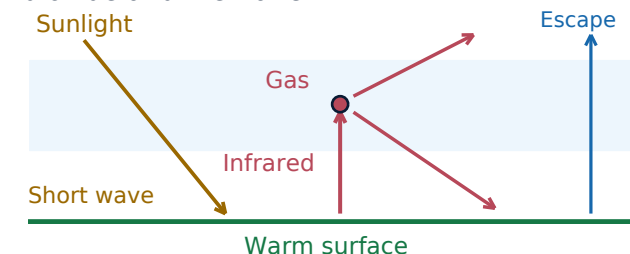
**Oil and gas:** tiny marine organisms. Burial with limited oxygen, then heat and pressure over millions of years.

## Climate evidence

## Air pollution

### 3 The greenhouse effect

**Greenhouse gases:** water vapour, carbon dioxide and methane.



Surface emits **long-wave infrared**. Gases absorb some and emit infrared in all directions, including downwards. Some escapes to space.

**More greenhouse gases → extra warming.**

### 4 People, climate and evidence

**More CO<sub>2</sub>:** fossil-fuel combustion; deforestation reduces uptake and may release stored carbon.

**More methane:** livestock digestion; organic waste decaying in landfill.

**Four potential effects:**

1. Sea-level rise (expansion + land ice melt).
2. Rainfall changes: drought or flooding.
3. More frequent or severe heatwaves.
4. Habitat and species-distribution changes.

**Evaluate evidence:** long records, wide coverage, clear methods, uncertainty and peer review. A cold week does not disprove a long-term trend. Regional risks vary.

### 5 Carbon footprints and reductions

**Full life cycle:** total CO<sub>2</sub> and other greenhouse-gas emissions. Include materials, manufacture, transport, use and disposal. CO<sub>2</sub>e combines gases on a common basis.

**Illustrative example, same service:**

A = 80 kg CO<sub>2</sub>e; B = 60 kg CO<sub>2</sub>e.

Saving = 20 kg CO<sub>2</sub>e.

Percentage saving =  $20 / 80 \times 100 = 25\%$ .

**CO<sub>2</sub>:** use less energy; lower-carbon sources; protect forests.

**Methane:** capture landfill gas, reduce food waste and prevent leaks.

**Limits:** cost, infrastructure, technology and behaviour.

### 6 Pollutants: source and effect

**Carbon monoxide:** incomplete combustion with limited oxygen. Toxic; reduces oxygen transport in blood. Colourless and odourless.

**Sulfur dioxide:** sulfur in fuel burns. Causes breathing problems and acid rain.

**Nitrogen oxides:** nitrogen + oxygen in air react at high temperature. Cause breathing problems and acid rain.

**Particulates:** soot and unburned material. Harm health; reduce sunlight reaching the ground (**global dimming**). This differs from greenhouse infrared absorption.