AQA GCSE Chemistry: Topic 9

"Grade 7" Examiner Cheat Sheet — The Atmosphere

Section 1: The Modern Atmosphere

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

Gas	Percentage	Fractional Equivalent
Nitrogen (N_2)	$\sim$80%	Approx. 4/5 of the atmosphere.
Oxygen (O_2)	$\sim$20%	Approx. 1/5 of the atmosphere.
Other Gases	$< 1\%$	Carbon dioxide, water vapour, noble gases.

Section 2: The Evolution Algorithm (4.6 Billion Years)

Phase 1: Intense Volcanic Activity (First Billion Years)

- Earth was a molten ball. Volcanoes released CO_2, H_2O (vapour), and N_2.
- Result: Atmosphere was mainly CO_2, with little or no O_2.

Phase 2: Formation of Oceans & CO_2 Decrease

- Earth cooled; water vapour **condensed** to form oceans.
- CO_2 dissolved in oceans. Carbonates were **precipitated** as sediments (limestone).

Phase 3: The Rise of Oxygen (Photosynthesis)

- Algae evolved (2.7bn years ago); plants followed.
- Plants took in CO_2 and released O_2 via photosynthesis:

$$6CO_2 + 6H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2$$

Section 3: How CO_2 Levels Decreased (The 3 Sinks)

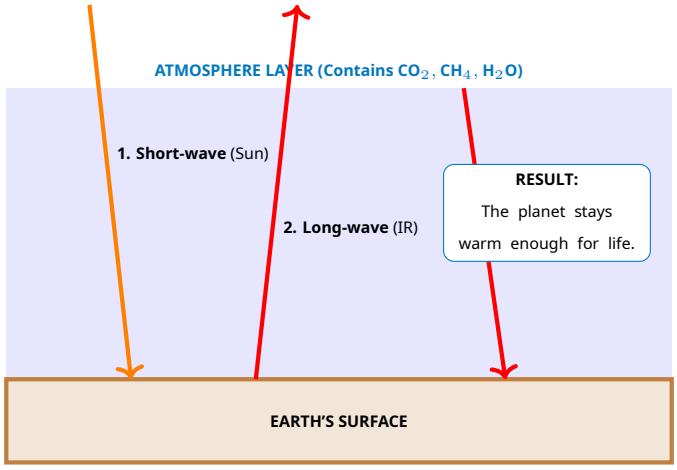
Examiner Note: You must explain where the carbon went.

1. **Sedimentary Rocks:** Carbon "locked up" in limestone (calcium carbonate).
2. **Fossil Fuels:** Coal, crude oil, and natural gas formed from dead biomass.
3. **Photosynthesis:** Algae and plants used CO_2 to make food.

Trap Check: Evidence for the early atmosphere is **limited** due to the vast time scale.

Section 4: The Greenhouse Effect Mechanism

Greenhouse gases (e.g. CO_2, CH_4, H_2O) act as an insulating layer.



The 4-Mark Mechanism Algorithm:

1. **Short-wave radiation** from the sun passes through the atmosphere.
2. Earth absorbs this energy and re-emits it as **Long-wave (infrared) radiation**.
3. Greenhouse gases in the atmosphere **absorb** the outgoing long-wave radiation.
4. This traps the energy, causing the temperature of the Earth to rise.

Section 5: Human Activities Increasing GHGs

1. Carbon Dioxide (CO_2):

- **Combustion:** Burning fossil fuels for industry, heating, and transport.
- **Deforestation:** Cutting down trees which would otherwise remove CO_2.

2. Methane (CH_4):

- **Agriculture:** Livestock (cattle) produce methane during digestion.
- **Waste Disposal:** Decomposition of waste in landfill sites.

Section 6: Global Climate Change

Scientific Consensus: Human activities will cause the Earth's temperature to increase, based on **peer-reviewed evidence**.
Consequence Matrix (Potential Effects):

Category	Specific Impact
Sea Levels	Melting ice caps and thermal expansion lead to **flooding**.
Weather	Increased frequency and severity of **storms** and droughts.
Ecosystems	Habitat loss and changes in the distribution of species.
Food Production	Difficulty in growing crops due to changed rain patterns.

Section 7: The Carbon Footprint

Definition: The total amount of CO_2 and other greenhouse gases emitted over the **full life cycle** of a product, service, or event.
Reduction Strategies (How to lower it):

- Use **renewable energy** sources (wind, solar) instead of fossil fuels.
- Improve **energy efficiency** (better insulation, smart tech).
- **Carbon Capture and Storage:** Trapping CO_2 at source.
- Carbon taxes or offsetting (e.g. planting trees).

Barriers to Action: 1. **Economic** (cost). 2. **Social** (inconvenience). 3. **Political** (international disputes).

Section 8: Atmospheric Pollutants from Fuels

Combustion of fuels releases **energy** and several pollutants. Most fuels contain carbon and hydrogen, and many also contain **sulfur**.

The Combustion Algorithm:

1. **Complete Combustion:** $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.
2. **Incomplete Combustion:** Limited O_2. Produces **Carbon Monoxide (CO)** or **Soot (Particulates)**.

Section 9: The Pollutant Master Matrix

Pollutant	Formation	Specific Danger
Carbon Monoxide	Incomplete combustion.	**Toxic gas**; binds to blood cells. Odourless and Colourless.
Sulfur Dioxide	Burning fuel with sulfur impurities.	Causes **Acid Rain** and respiratory problems.
Nitrogen Oxides	Nitrogen reacts with oxygen in **hot engines**.	Causes **Acid Rain** and triggers asthma.
Particulates	Unburnt fuel (Soot).	Causes **Global Dimming** and lung damage.

Section 10: Summary Trap Check

Highest-Yield Exam Points:

- **Acid Rain:** Damaging to buildings, trees, and aquatic life.
- **Global Dimming:** Particulates reflect sunlight back into space.
- **CO Detection:** It is a "silent killer" because humans cannot detect it without a specific sensor.

"Topic 9 Complete. Mastery of pollutants and Earth's history is key for Paper 2."