Chemistry of the Environment

IGCSE Chemistry ▪ Topic 10

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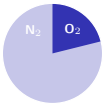


What we will cover

1. Water: testing & treating
2. Fertilisers
3. The composition of air
4. Air pollutants & their effects
5. The greenhouse effect
6. Reducing pollution

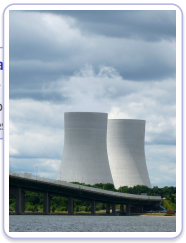
1 Water

Water: testing and purity

is water present?
anhydrous 无水 cobalt chloride blue→pink; copper sulfate white→blue

is wa
pure water 0 °C & b impurities

Natural water carries dissolved O_2, minerals, **nitrates** 硝酸盐 & **phosphates** 磷酸盐 (which cause **deoxygenation** 缺氧), and microbes.



Air pollution harms health and the environment

Treating drinking water

sedimentation — large bits settle to the bottom
↓
filtration — remove the remaining solid bits
↓
pass through **carbon** — removes bad tastes and smells
↓
chlorination — chlorine kills harmful microbes
↓
safe drinking water

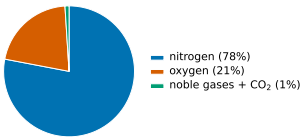
Steps to make water safe:

- **sedimentation** 沉降 & **filtration** 过滤 remove solids
- **carbon** 碳 removes tastes & smells
- **chlorination** 氯消毒 kills microbes

Fertilisers 肥料 (NPK) add nitrogen, phosphorus & potassium.

2 Air

The composition of air



Clean, dry air:

- 78% **nitrogen** 氮气 (N_2)
- 21% **oxygen** 氧气 (O_2)
- ~1% noble gases & CO_2

Air pollutants and their sources

CO_2 – complete **combustion** 燃烧 of carbon fuels (a greenhouse gas)

CO & particulates – **incomplete combustion** 不完全燃烧 of fuels

oxides of nitrogen – hot car engines

sulfur dioxide – burning fuels that contain **sulfur** 硫

Effects of pollutants

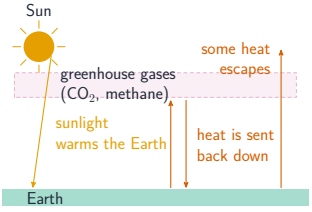
CO_2 & **methane** 甲烷: greenhouse → global warming

SO_2 & NO_x: **acid rain** 酸雨

carbon monoxide: a toxic gas

particulates 颗粒物: breathing problems

The greenhouse effect



greenhouse gases trap some of the Earth's heat, so less escapes to space and the Earth warms up

Greenhouse gases 温室气体 let sunlight in but absorb the heat the Earth gives off.

> Less heat escapes to space, so the Earth warms – driving **climate change** 气候变化.

Reducing pollution

- climate: trees, less fossil fuel, **renewable energy** 可再生能源
- acid rain: **catalytic converters** 催化转化器, low-sulfur fuels

$$2CO + 2NO \rightarrow 2CO_2 + N_2$$

3 Recap

Worked example – stopping rust

Iron rusts but zinc-coated iron does not, even when the coating is scratched. Explain.

- Rusting needs both oxygen and water.
- A coat of paint or plastic works only as a barrier – scratch it and rust starts.
- Zinc is more reactive than iron, so it loses electrons in preference.
- The zinc corrodes instead ⇒ sacrificial protection, which still works when scratched.

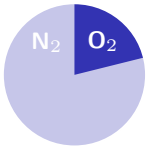
Barrier methods fail once broken; sacrificial protection does not, because the more reactive metal is oxidised instead. Galvanising does both at once.

Topic 10 – key takeaways

1. **Water** — settle, filter, carbon, chlorinate
2. **Air** — 78% N_2, 21% O_2, ∼1% other
3. **Pollutants** — CO_2/CH_4 warm; SO_2/NO_x acid rain
4. **Greenhouse** — traps the heat the Earth gives off

Check yourself

1. What step in water treatment kills microbes?
2. What are the two main gases in clean air?
3. Which two pollutants cause acid rain?
4. Why does the greenhouse effect warm the Earth?



Answers **1.** chlorination **2.** nitrogen & oxygen **3.** sulfur dioxide & oxides of nitrogen **4.** it traps heat the Earth radiates