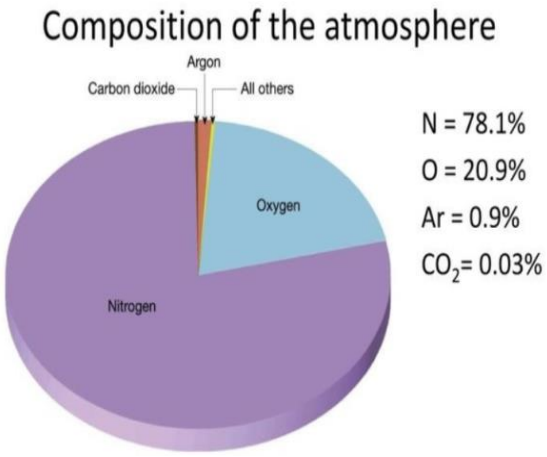
Pakistan Excel English School

IGCSE Chemistry (0620) notes

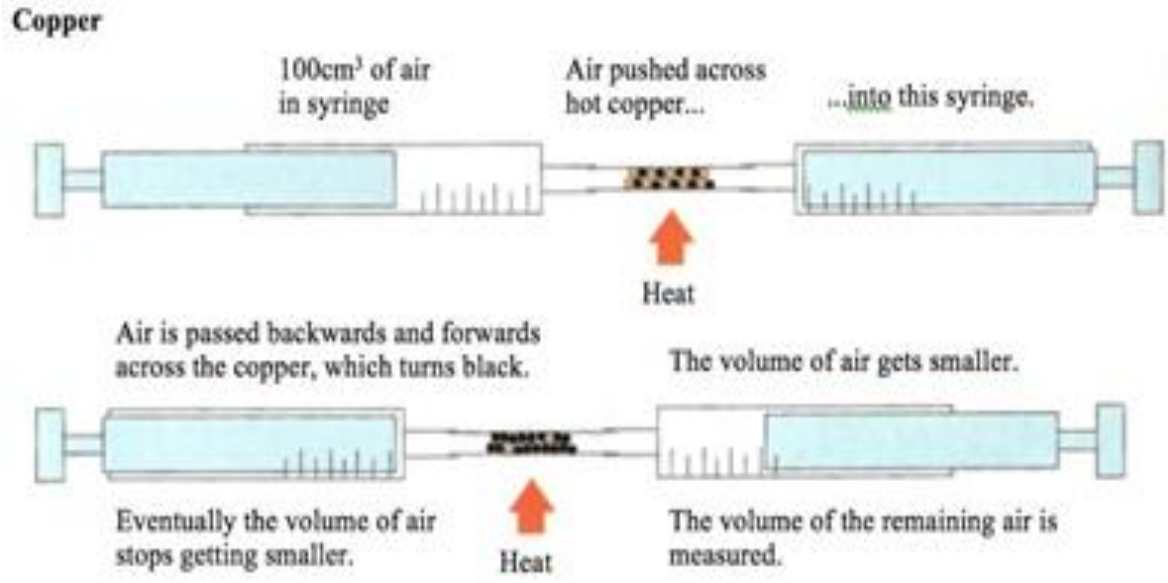
Topic 11.2 Air *Prepared by Ms. Sadaf Shabbir*

- **Composition of air**

Clean air is approximately 78% nitrogen, 21% oxygen , argon 0.9% and the remainder is a mixture of noble gases, water vapour and carbon dioxide.



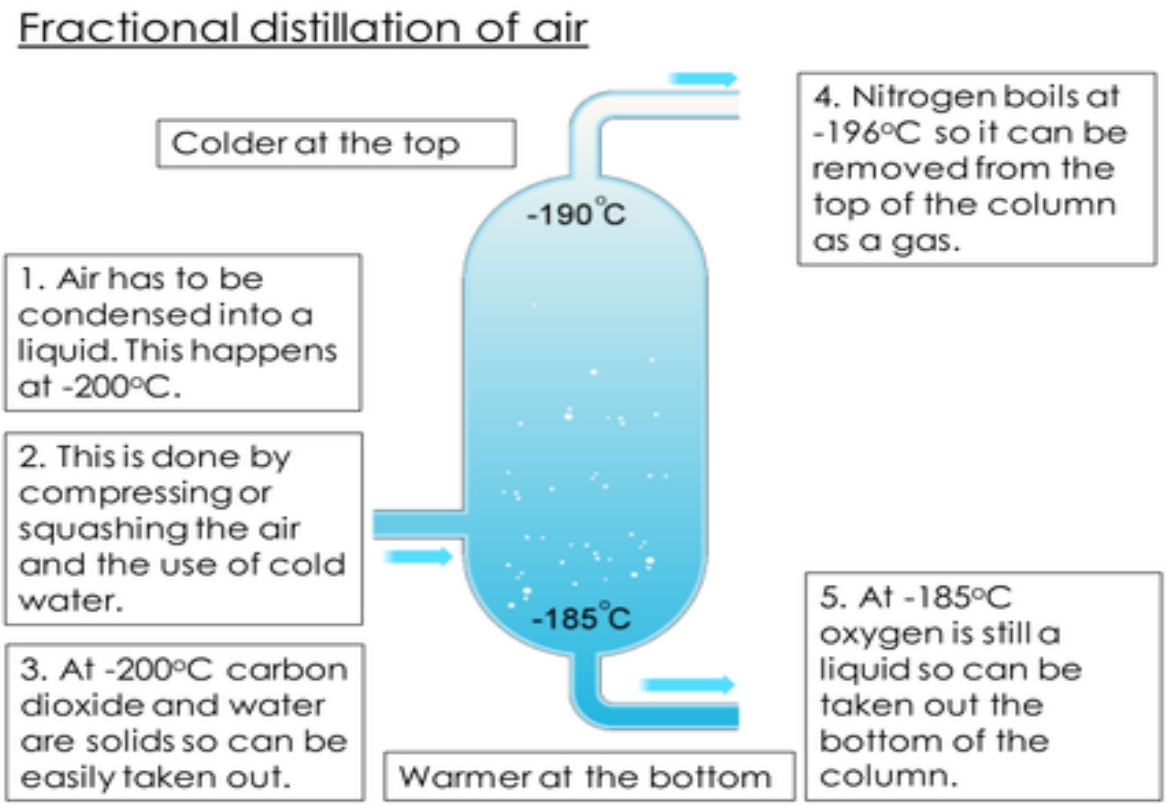
Experiment to find out percentage of oxygen in air



- We start with 100cm^3 of air in one syringe and none in other
- We pass the air over the heated copper by pushing the gas syringe back and forth until the volume of the gases in the syringes remain constant
- After that the total volume of gas in the syringes is 79cm^3 (100 – 79 = 21%) Because percentage of oxygen in air is 21% .

Fractional Distillation of Air

- The air is first filtered to remove dust, and then cooled in stages until it reaches –200°C.
- At this temperature the air is in the liquid state.
- Water vapour and carbon dioxide freeze at higher temperatures and are removed using absorbent filters.
- The Noble gases are still in the gaseous state at -200ºC, leaving a mixture of liquid nitrogen and oxygen.
- The liquefied mixture is passed into the bottom of a fractionating column.
- Note that the column is warmer at the **bottom** than it is at the top.
- Oxygen liquefies at -183°C and nitrogen liquefies at -196°C.
- Nitrogen has a lower boiling point than oxygen so it vaporises first and is collected as it rises in the gaseous state to the **top** of the column.
- The liquid O_2 is then removed from the **bottom** of the column.



Common pollutants and their effects

Air pollutants	sources	effects
carbon monoxide	incomplete combustion of carbon-containing substances	reacts with haemoglobin, preventing it from carrying oxygen –,dizziness, headache, can lead to death
sulphur dioxide	combustion of fossil fuels containing sulphur compounds and sulfide ores	irritates eyes and throat, causes respiratory problems and causes **acid rain (**corrosion to metal structures, buildings and statues)
nitrogen oxides	hot furnaces and engines , car exhaust, bacterial action in soil	causes respiratory problems, forms **acid rain**.
lead compounds	*old water pipes,* leaded petrol(*a lead compound is added to petrol to help it burn more smoothly)*	damage brain in kids, nervous system and kidney in adults

Nitrogen oxides

These compounds (NO and NO_2) are formed when nitrogen and oxygen react in the **high pressure** and **temperature** conditions of internal combustion engines in cars and blast furnaces.

Exhaust gases also contain unburned hydrocarbons and carbon monoxide.

Cars are fitted with **catalytic converters** which form a part of their exhaust systems.

Catalytic converters

Purpose

It is a device that converts polluting car exhaust fumes into normal gases in air to reduce pollution from air.it should be used with lead free petrol otherwise lead can poison the catalyst in device.

Mode of action

It removes the polluting oxides i.e. CO and NO and completes the oxidation of unburnt hydrocarbons. It provides a honeycomb surface with thin coating of Platinum and rhodium catalysts on which gases react

Reactions

$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

$2NO_{(g)} + 2CO_{(g)} \rightarrow N_{2(g)} + 2CO_{2(g)}$

$2NO_{(g)} \rightarrow N_{2(g)} + O_{2(g)}$

Hydrocarbons + oxygen → Carbon dioxide + water

- **Acid rain effects**
  - Limestone buildings, statues are worn away
  - Lakes are acidified
  - Trees become unable to draw up water and get deprived from nutrients
- **Ways to reduce pollution**
  - Use less fossil fuel
  - Switch to clean sources of power
  - Try to find ways to store CO_2 and not let it escape to the atmosphere
  - Use of catalytic converters

- **Corrosion**

When a metal is attacked by air, water, or other surroundings substances, the metal is said to corrode.

The more reactive a metal is, the more readily it corrodes

- **Rusting of iron**

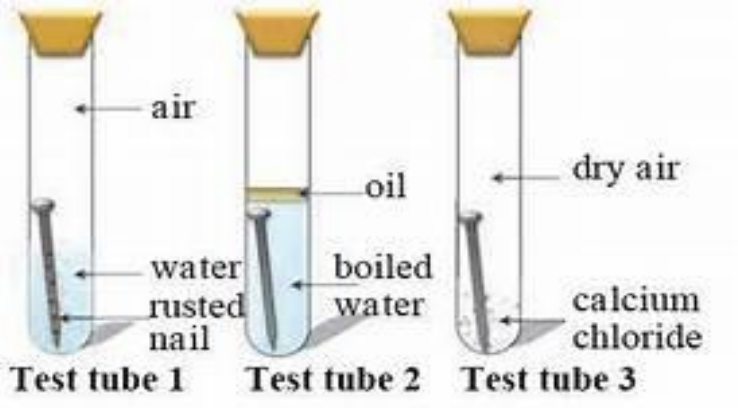
Rusting is a chemical reaction between iron, water and oxygen that forms the compound iron (III) oxide. **Oxygen and water** must be present for rust to occur.

Rusting is a redox process and it occurs faster in salty water since the presence of sodium chloride increases the electrical conductivity of the water.

Iron +Water + Oxygen $\rightarrow$ hydrated Iron (III) Oxide

$4Fe(s) + 3O_2(g) + xH_2O(l) \rightarrow 2Fe_2O_3.xH_2O(s)$

- **Experiment**



- **Barrier Methods of Rust Prevention**

Rust can be prevented by coating iron with barriers that prevent the iron from coming into contact with water and oxygen.

However, if the coatings are washed away or scratched, the iron is once again exposed to water and oxygen and will rust.

- **Coat the metal with something to keep out air and moisture.**
- **Paint** (protective layer for ships , bridges but regular repainting needed)
- **Grease and oil** (protective layer for moving parts of machinery but regular greasing needed)
- **Plastic coating** (protective layer for refrigerators and chairs)
- **Electroplating** (chromium or tin coating layer is used for steel, iron)
- **Galvanising** (coating with more reactive metal e.g, zinc)

- **Galvanising**

Galvanising is a method of rust prevention. The iron or steel object is coated in a thin layer of zinc.

This stops oxygen and water reaching the metal underneath - but the zinc also acts as a **sacrificial metal**.

- **Sacrificial protection**

More reactive metal (Mg or Zn) is attached to the iron which corrodes instead of the iron. This is called **sacrificial protection**.

The reactive metal bar gets oxidised and save the iron even If the coating is damaged or scratched.

$Zn \rightarrow Zn^{2+} + 2e^-$

The iron stays protected as it accepts the electrons released by zinc, remaining in the reduced state and thus it does not undergo oxidation.

The electrons donated by the zinc react with hydrogen ions in the water producing hydrogen gas:

$2H^+ + 2e^- \rightarrow H_2$

Zinc therefore reacts with oxygen and water and corrodes instead of the iron.

Examples

- Zn or Mg bars are attached to hulls of ships Or oil rig
- Underground pipes are connected by magnesium block