BioMedical Admissions Test (BMAT)

Section 2: Chemistry

Topic C17: Air and Water

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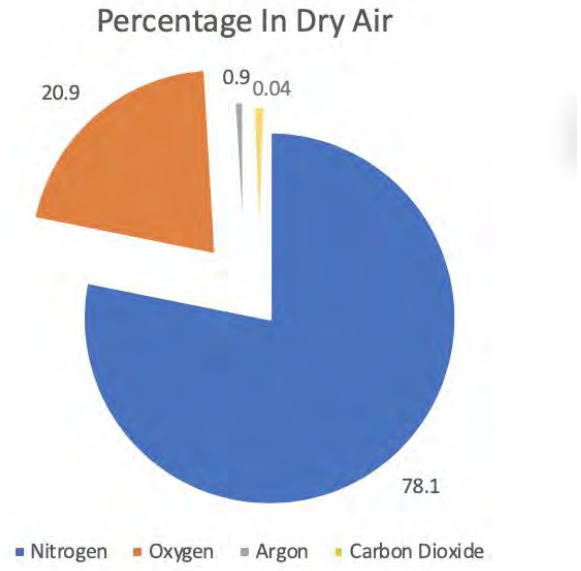
Gases in Air

Air is made up of a variety of gases in proportions shown in the pie chart.

- Water can be present (~5% max)



Uses of the gases

- **Liquid nitrogen** is used to cool to low temperatures (e.g. sperm in hospitals)/
- **Gaseous nitrogen** is used to prevent food going off in sealed containers.
- In industry nitrogen is used to make ammonia – which then makes **fertilisers**.
- **Oxygen** is used in medicine – e.g. for those with reduced breathing ability.
- It is also used in industry to remove iron impurities.

Separation by fractional distillation

We use **fractional distillation** to separate the gases so we can use them. The process is as follows:

- The gases are cooled to temperatures of below -200^{O}C.
- This is achieved by increasing the pressure to 150x air pressure then passing over pipes of cold water before releasing the pressure.
- This causes the liquids to condense as liquids.
- Before this stage CO_2 and H_2O are removed as they would solidify, breaking the machinery used.
- The mixture of nitrogen, oxygen and argon is then warmed slowly.
- Nitrogen (b.p. -196°C) boils off first and so is collected at the top of the column.
- Argon (b.p -186) is next in the column.
- Oxygen is tapped off as a liquid at the bottom.

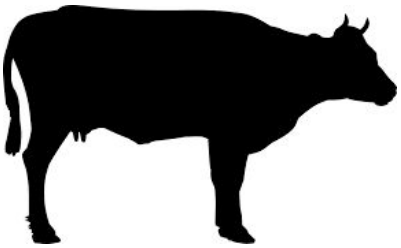
Greenhouse Gases

Greenhouse gases are gases which trap heat in our atmosphere.

- We need a certain level of them for high enough temperatures to maintain life on Earth.
- Methane, water vapour, and carbon dioxide are examples.

Causes of **Methane**:

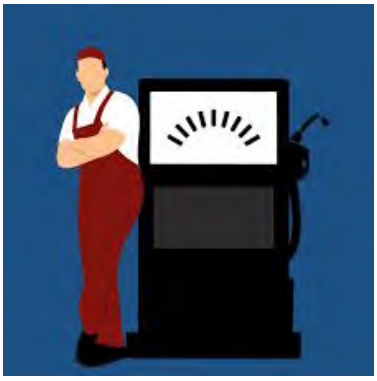
Rice fields



Cattle farming

Landfills

Causes of **CO_2**:



Burning Fossil Fuels

Deforestation

For BMAT you need to know the origins and effects of gaseous pollutants such as carbon monoxide, carbon dioxide, nitrogen oxides, and sulfur dioxide. These are summarised in the table below:

Gas	Sources/Sinks	Effects
Carbon Monoxide (CO)	Sources: Gas fires, gas boilers, vehicle engines	Poisonous gas
Carbon Dioxide (CO_2)	Sources – respiration, decay, escaping from being dissolved in water, fossil fuel burning, Sinks – Photosynthesis, dissolving into water	Increased global temperature
Sulfur Dioxide (SO_2)	Sources: Fuel impurities	Poisonous gas, acid rain, triggers asthma
Nitrous Oxides (NOx)	Sources: Reaction of air in engines	Toxic gas, acid rain, triggers asthma

Carbon monoxide is colourless and odourless.

- ➔ It binds to haemoglobin more strongly than oxygen reducing its ability to bind to O_2.
- ➔ Exposure leads to headaches and drowsiness and eventually death.

Sulfur dioxide is also colourless.

- ➔ It can cause acid rain which has aesthetic effects by corroding stonework and effects on wildlife by increasing leaching of minerals from soil and harming marine life and other animals.

Nitrous oxides (or Oxides of Nitrogen) also cause acid rain.

Drinking Water

To make it safe for consumption, water is treated with Cl_2 and F^-.

- Chlorine kills harmful bacteria.
- Fluoride reduces the chance of tooth decay.