

OCR 21st Century Core Science – Chemistry C1

AIR QUALITY

C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution?

- recall that the Earth is surrounded by an atmosphere made up mainly of nitrogen, oxygen and argon, plus small amounts of water vapour, carbon dioxide, and other gases;
- recall that the relative proportions of gases in the atmosphere are about 78% nitrogen, 21% oxygen and 1% argon;
- recall that human activity adds small amounts of carbon monoxide, nitrogen oxides and sulfur dioxide to the atmosphere;
- recall that human activity also adds extra carbon dioxide and small particles of solids (e.g. carbon) to the atmosphere;
- recall that some of these substances, called pollutants, are directly harmful to humans and some are harmful to the environment and so cause harm to humans indirectly;
- when using data relating to measured concentrations of atmospheric pollutants, or the composition of the atmosphere:
 - uses data rather than opinion in justifying an explanation;
 - can suggest reasons why a measurement may be inaccurate;
 - can suggest reasons why several measurements of the same quantity may give different results;
 - when asked to evaluate data, makes reference to its reliability (i.e. is it repeatable?);
 - can calculate the mean of a set of repeated measurements;
 - from a set of repeated measurements of a quantity, uses the mean as the best estimate of the true value;
 - can explain why repeating measurements leads to a better estimate of the quantity;
 - can make a sensible suggestion about the range within which the true value of a measured quantity probably lies;
 - **can justify the claim that there is/is not a 'real difference' between two measurements of the same quantity;**
 - can identify any outliers in a set of data, and give reasons for including or discarding them.

C1.2 What chemical reactions produce air pollutants? What happens to these pollutants in the atmosphere?

- recall that coal is mainly carbon;
- recall that petrol, diesel fuel and fuel oil are mainly compounds of hydrogen and carbon (hydrocarbons);
- recall that, when fuels burn, atoms of carbon and/or hydrogen from the fuel combine with atoms of oxygen from the air to produce carbon dioxide and/or water (hydrogen oxide);
- recall that atoms are rearranged during a chemical reaction;
- interpret representations of the rearrangement of atoms during a chemical reaction;
- understand that during the course of a chemical reaction the numbers of atoms of each element must be the same in the products as in the reactants;
- understand that the conservation of atoms during combustion reactions has implications for air quality;
- recall that the properties of the reactants and products are different;
- understand how sulfur dioxide is produced if the fuel contains any sulfur;
- understand how burning fossil fuels in power stations and for transport pollutes the atmosphere with:
 - carbon dioxide and sulfur dioxide,
 - carbon monoxide and particulate carbon (from incomplete burning),
 - nitrogen oxides (from the reaction between atmospheric nitrogen and oxygen at the high temperatures inside engines);
- relate the formulas for carbon dioxide CO₂, carbon monoxide CO, sulfur dioxide SO₂, nitrogen monoxide NO, nitrogen dioxide NO₂, and water H₂O, to visual representations of their molecules;
- **recall that nitrogen monoxide NO, is formed during the combustion of fuels in air, and is subsequently oxidised to nitrogen dioxide NO₂. (NO and NO₂ are jointly referred to as 'NOx');**
- understand that atmospheric pollutants cannot just disappear, they have to go somewhere:
 - particulate carbon is deposited on surfaces, making them dirty;
 - sulfur dioxide and nitrogen dioxide react with water and oxygen to produce acid rain;

- carbon dioxide is used by plants in photosynthesis;
- carbon dioxide dissolves in rain water and in sea water.
- Candidates are not required to write word or symbol equations.

C1.3 Is air pollution harmful to me, or to my environment?

- when given data relating to the effect of air quality:
 - can identify the absence of replication as a reason for questioning a scientific claim;
 - **can explain why scientists regard it as important that a scientific claim can be replicated by other scientists;**
 - can identify the outcome and the factors that may affect it;
 - can suggest how an outcome might be affected when a factor is changed;
 - can give an example from everyday life of a correlation between a factor and an outcome;
 - uses the ideas of correlation and cause appropriately when discussing historical events or topical issues in science;
 - **can explain why a correlation between a factor and an outcome does not necessarily mean that one causes the other, and can give an example to illustrate this;**
 - can suggest factors that might increase the chance of an outcome, but not invariably lead to it;
 - can explain that individual cases do not provide convincing evidence for or against a correlation.

C1.4 What choices can we make personally, locally, nationally or globally to improve air quality?

- understand how atmospheric pollution caused by power stations which burn fossil fuels can be reduced by:
 - using less electricity;
 - removing sulfur from natural gas and fuel oil;
 - removing sulfur dioxide and particulates (carbon and ash) from the flue gases emitted by coal-burning power stations;
- understand that the only way of producing less carbon dioxide is to burn less fossil fuel;
- understand how atmospheric pollution caused by exhaust emissions from motor vehicles can be reduced by:
 - burning less fuel by having more efficient engines;
 - using low sulfur fuels;
 - using catalytic converters, which convert nitrogen monoxide to nitrogen and oxygen, and carbon monoxide to carbon dioxide;
 - adjusting the balance between public and private transport;
 - having legal limits to emissions (which are enforced by the use of MOT tests).
- in the context of emissions of pollutants into the atmosphere, shows awareness that scientific research and applications are subject to official regulations and laws.