OCR B GCSE Chemistry

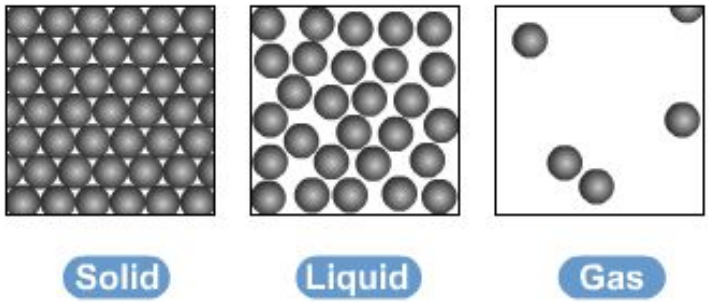
Topic 1: Air and water

How has the Earth's atmosphere changed over time, and why?

Notes

1. Recall and explain the main features of the particle model in terms of the states of matter and change of state, distinguishing between physical and chemical changes and recognise that the particles themselves do not have the same properties as the bulk substances

- The three states of matter are solid, liquid and gas
- Melting and freezing take place at the melting point
- Boiling and condensing take place at the boiling point



- They can be represented by the simple model above, particles are represented by small solid spheres
- Chemical changes – require a chemical reaction, and for there to be a change from reactants to products, i.e. what you produce is chemically different from what you react
- Physical changes – require energy, and involve changes in state
    - Melting, boiling, freezing, condensing are all examples of physical changes
- A particle has different properties to the 'bulk' chemical it's made from, because of their high surface area to volume ratio. It may also mean that smaller quantities are needed to be effective than for materials with normal particle sizes. e.g fullerenes have different properties to big lumps of carbon.

2. (HT only) explain the limitations of the particle model in relation to changes of state when particles are represented by inelastic sphere

- Limitations – does not take into account
    - The forces of attraction between particles
        - The amount of energy needed to change state from solid to liquid and from liquid to gas depends on the strength of the forces between the particles of the substance.
        - The stronger the forces between the particles the higher the melting point and boiling point of the substance.
    - The size of particles & the space between the particles
        - The nature of the particles involved depends on the type of bonding and the structure of the substance (e.g. spaces between particles)

3. Use ideas about energy transfers and the relative strength of forces between particles to explain the different temperatures at which changes of state occur

- Energy transfer
    - Energy transferred TO a compound – melting, boiling
    - Energy transferred FROM a compound – condensing, freezing
- Relative strength of forces between particles
    - Strong forces between particles mean high boiling and melting points
    - Weak forces mean low(er) boiling and melting points
- All of these factors result in different temperatures at which substances change state

4. Use data to predict states of substances under given conditions

- temperatures below melting point: solid
- temperatures in between melting point and boiling point: liquid
- temperatures above boiling point: gas

5. Interpret evidence for how it is thought the atmosphere was originally formed

- Evidence is limited because of the time scale of 4.6 billion years
- One theory suggests that during the first billion years of the Earth's existence…
    - There was intense volcanic activity that released gases that formed the early atmosphere
        - At the start of this period, the atmosphere may have been like the atmospheres of Mars and Venus today, mainly CO_2 with little or no $O_2(g)$
        - Volcanoes also produced nitrogen which gradually built up in the atmosphere & there may have been small proportions of methane (CH_4) and NH_3
    - Water vapour condensed to form the oceans
        - CO_2 dissolved in the water and carbonates were precipitated producing sediments, reducing the amount of CO_2 in the atmosphere

6. Describe how it is thought an oxygen-rich atmosphere developed over time

- Algae & plants produced the O_2 that is now in the atmosphere by photosynthesis

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

carbon dioxide + water –(light)-> glucose + oxygen

- Algae first produced oxygen about 2.7 billion years ago and soon after this oxygen appeared in the atmosphere
- Over the next billion years plants evolved and the % oxygen gradually increased to a level that enabled animals to evolve

7. Describe the major sources of…

- Carbon monoxide and particulates- incomplete combustion
- Sulfur dioxide- combustion of sulfur impurities in fuels
- Oxides of nitrogen- oxidation of nitrogen at high temperatures and further oxidation in the air

8. Explain the problems caused by increased amounts of these substances and describe approaches to decreasing the emissions of these substances into the atmosphere

- Problems caused by increased amounts of these substances
    - Sulfur dioxide and oxides of nitrogen cause acid rain and solid particles cause global dimming.
    - Carbon monoxide is toxic – causing breathing difficulties
- Approaches to decrease the emissions of these substances into the atmosphere
    - Catalytic converters
        - In car engines – preventing carbon monoxide and oxides of nitrogen to be released – these are instead converted to carbon dioxide and nitrogen
    - Low sulfur petrol
        - Prevents release of sulfur dioxide
    - Gas scrubbers

9. Use chemical symbols to write the formulae of elements and simple covalent compounds

- Elements
  - Substances that cannot be broken down into simpler substances by chemical means
  - The basic building blocks of all substances
  - Substances made up of only one type of atom
  - Represented by symbol on periodic table, e.g. Hydrogen represented as H and Potassium as K
- Compounds
  - Substances made of two or more different types of atom that are chemically joined and having completely different properties to its constituent elements
  - E.g. of a simple covalent compound: water: H_2O

10. Use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations

- Law of conservation of mass: no atoms are lost or made during a chemical reaction so the mass of the products = mass of the reactants
  - Therefore, chemical reactions can be represented by symbol equations, which are balanced in terms of the numbers of atoms of each element involved on both sides of the equation.

11. Use arithmetic computations and ratios when balancing equations

- Balancing equations:
  - Count the number of each element that reacts (remember to take into account big numbers at the front of compounds and little subscript numbers within the formula of a compound)
  - Compare this to the number of each element that is produced
  - Balance the equation by making the numbers equal on both sides
  - E.g. $HCl + MgO \rightarrow MgCl_2 + H_2O$
    - There's 2 x Cl and 2 x H on the right, but only 1 x Cl and 1 x H on the left
    - Must put a 2 in front of HCl on the left to balance
    - This makes: $2HCl + MgO \rightarrow MgCl_2 + H_2O$

12. Describe tests to identify oxygen, hydrogen and carbon dioxide

- Oxygen
  - Uses a glowing splint inserted into a test tube of the gas
    - Splint relights in oxygen
- Hydrogen
  - Use a burning splint held at the open end of a test tube of the gas
    - Creates a 'squeaky pop' sound
- Carbon dioxide
  - bubble the gas through the limewater (calcium hydroxide) and it will turn milky (cloudy)

13. Explain oxidation in terms of…

- gain of oxygen
- Oxidation is gain of oxygen, reduction is loss of oxygen