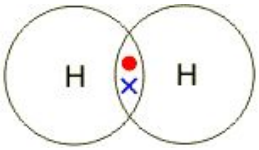
Edexcel GCSE Chemistry

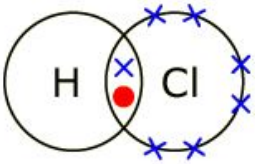
Topic 1: Key concepts in chemistry

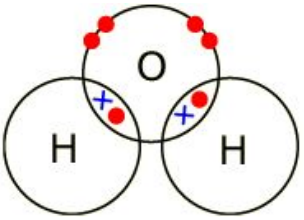
Types of substance

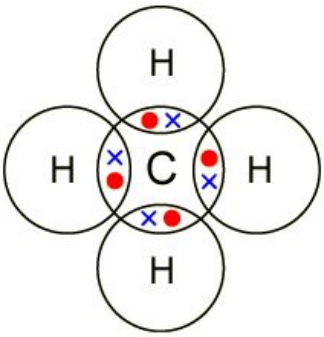
Notes

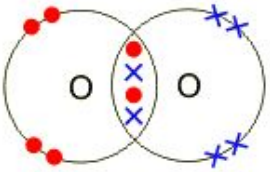
1.31 Explain the formation of simple molecular, covalent substances, using dot and cross diagrams, including: hydrogen, hydrogen chloride, water, methane, oxygen, and carbon dioxide

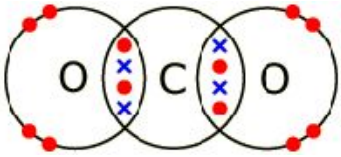












1.32 Explain why elements and compounds can be classified as: ionic, simple molecular (covalent), giant covalent, metallic and how the structure and bonding of these types of substances results in different physical properties, including relative melting point and boiling point, relative solubility in water and ability to conduct electricity (as solids and in solution)

Properties of ionic compounds

- Ionic compounds are made up of a metal and a nonmetal
- Ionic compounds have regular structures (giant ionic lattices) in which there are strong electrostatic forces of attraction in all directions between oppositely charged ions.
- They have high melting and boiling points, because a lot of energy is required to break the many strong bonds.
- When melted or dissolved in water, ionic compounds conduct electricity because the ions are free to move and carry current, and they do not conduct electricity as solids, because the ions are fixed and are not able to move, carrying charge with them.
- Often dissolve in water to form an aqueous solution

Properties of simple molecular compounds

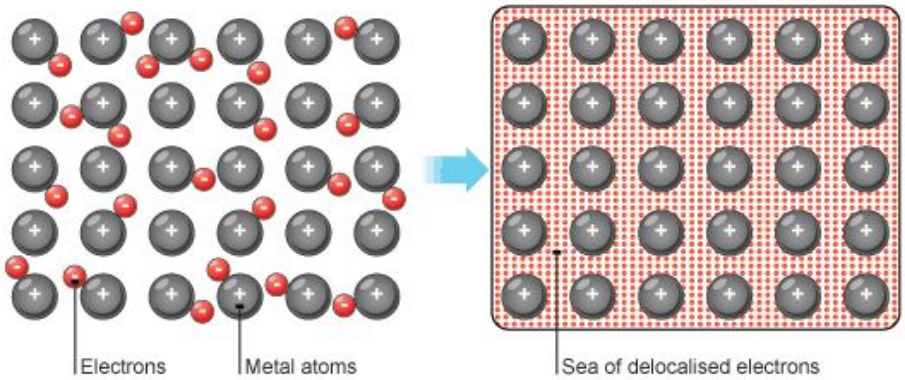
- Substances that consist of small molecules are usually gases or liquids that have low boiling and melting points. They are made up of nonmetal elements.
- Substances that consist of small molecules have weak intermolecular forces between the molecules. These are broken in boiling or melting, not the covalent bonds.
    - The intermolecular forces increase with the size of the molecules, so larger molecules have higher melting and boiling points.
- Substances that consist of small molecules don't conduct electricity, because small molecules do not have an overall electric charge. although, some breakdown in water to form ions which can conduct electricity
- Many are insoluble in water, but some are soluble because they can form intermolecular forces with water which are stronger than those between water molecules or their own molecules already (e.g. CO_2 and NH_3 are soluble)

Giant Covalent Structures

- They are made up of nonmetal elements
- Substances that consist of giant covalent structures are solids with very high melting points.
    - All of the atoms in these structures are linked to other atoms by strong covalent bonds.
        - These bonds must be overcome to melt or boil these substances.
- some giant covalent structures can conduct electricity, whereas others can't

Properties of metals

- Metals consist of giant structures of atoms arranged in a regular pattern. They are always made up of just metallic elements
- The electrons in the outer shell of metal atoms are delocalised and so are free to move through the whole structure.
- The sharing of delocalised electrons gives rise to strong metallic bonds.



- Metals have giant structures of atoms with strong metallic bonding.
    - Therefore, most metals have high melting and boiling points.
    - They can conduct heat and electricity because of the delocalised electrons in their structures.
    - Conduction depends on the ability for electrons to move throughout the metal.
    - The layers of atoms in metals are able to slide over each other, so metals can be bent and shaped.
    - insoluble in water- but some will react with it instead

1.33 Explain the properties of ionic compounds limited to: high melting points and boiling points, in terms of forces between ions and whether or not they conduct electricity as solids, when molten and in aqueous solution

- high melting and boiling points- strong electrostatic forces
- conduct electricity when molten/dissolved- ions can move
- don't conduct electricity when solid- ions are fixed in place

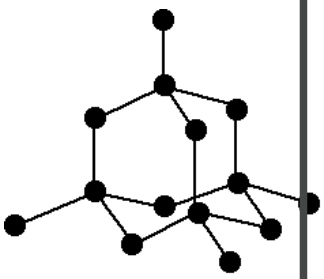
1.34 Explain the properties of typical covalent, simple molecular compounds limited to: low melting points and boiling points, in terms of forces between molecules (intermolecular forces) and poor conduction of electricity

- low melting and boiling points- only weak forces between molecules must be overcome, not covalent bonds
- poor conduction of electricity- no charged particles or electrons that are free to move

1.35 Recall that graphite and diamond are different forms of carbon and that they are examples of giant covalent substances
1.36 Describe the structures of graphite and diamond

Diamond

- In diamond (right), each carbon is joined to 4 other carbons covalently.
    - It's very hard, has a very high melting point and does not conduct electricity.



Graphite

- In graphite, each carbon is covalently bonded to 3 other carbons, forming layers of hexagonal rings, which have no covalent bonds between the layers.
    - The layers can slide over each other due to no covalent bonds between the layers, but weak intermolecular forces. Meaning that graphite is soft and slippery.
- One electron from each carbon atom is delocalised.
    - This makes graphite similar to metals, because of its delocalised electrons.
    - It can conduct electricity – unlike diamond.

1.37 Explain, in terms of structure and bonding, why graphite is used to make electrodes and as a lubricant, whereas diamond is used in cutting tools

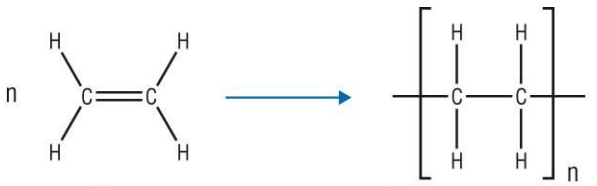
- Graphite uses
    - Electrodes – graphite can conduct electricity – unlike Diamond
    - Lubricant – weak intermolecular forces and no covalent bonds between the layers, therefore it is soft and slippery
- Diamond uses
    - Cutting tools – very hard, due to its rigid structure

1.38 Explain the properties of fullerenes including C_{60} and graphene in terms of their structures and bonding

- Graphene
  - Single layer of graphite
  - Has properties that make it useful in electronics and composites
- Carbon can also form fullerenes with different numbers of carbon atoms.
  - Molecules of carbon atoms with hollow shapes
  - They are based on hexagonal rings of carbon atoms, but they may also contain rings with five or seven carbon atoms
  - The first fullerene to be discovered was Buckminsterfullerene (C_{60}), which has a spherical shape
- Carbon nanotubes
  - Cylindrical fullerenes with very high length to diameter ratios
  - Their properties make them useful for nanotechnology, electronics and materials
- Examples of uses
  - They can be used as lubricants, to deliver drugs in the body and catalysts.
  - Nanotubes can be used for reinforcing materials, for example tennis rackets.

1.39 Describe, using poly(ethene) as the example, that simple polymers consist of large molecules containing chains of carbon atoms

- Polymers have very large molecules (the n in the diagram structure shows there are many many repeat units)
- Atoms in the polymer molecules are linked to other atoms by strong covalent bonds
- Intermolecular forces between polymer molecules are relatively strong and so these substances are solids at room temperature



Ethene — Poly(ethene) – *polythene*

1.40 Explain the properties of metals, including malleability and the ability to conduct electricity

- malleable- the layers of atoms in metals are able to slide over each other
- can conduct electricity- delocalised electrons can move