Cambridge IGCSE Chemistry

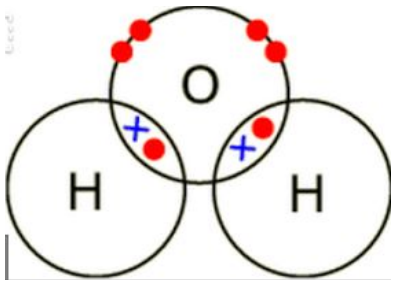
Topic 3: atoms, elements and compounds

Molecules and covalent bonds

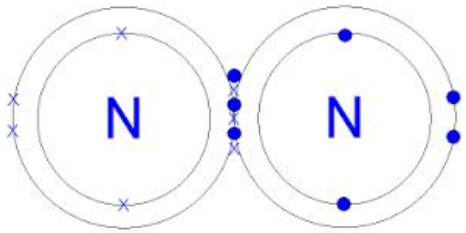
Notes

Describe the formation of single covalent bonds in H_2, Cl_2, H_2O, CH_4, NH_3 and HCl as…

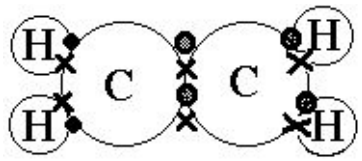
- The sharing of pairs of electrons leading to the noble gas configuration
- all of these compounds have single covalent bonds e.g. water (H_2O):



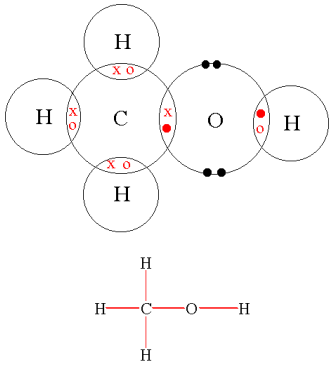
(Extended only) Describe the electron arrangement in more complex covalent molecules such as N_2, C_2H_4, CH_3OH and CO_2

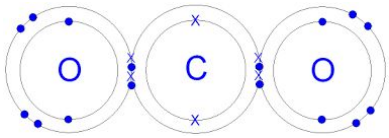


Triple bond



Double bond





2 x double bond

Describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds

- Volatility (ease of evaporation):
  - Covalent compounds: giant covalent structures have high melting/boiling points and so low volatility. Simple molecular covalent substances have low melting/boiling points so have high volatility
  - Ionic compounds: compounds have high melting and boiling points (low volatility)

- Solubility:
  - Ionic substances
    - Tend to be soluble in water, but insoluble in other covalently bonded solvents e.g. ethanol or propanone
  - Covalent substances
    - Opposite of ionic substances in terms of solubility
    - Soluble in covalent type solvents
    - Insoluble in water

- Electrical conductivity:
  - Covalent compounds do not conduct electricity – they have no free flowing particles able to carry charge (except for graphite)
  - Ionic compounds conduct electricity ONLY when molten or dissolved in aqueous solution, because then the ions are able to move and carry charge, conducting electricity - when solid, the ions are fixed

(Extended only) Explain the differences in melting point and boiling point of ionic and covalent compounds in terms of attractive forces

- Covalent compounds:
  - 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, which must be overcome to melt or boil these substances.
  - Substances that consist of small molecules are usually gases or liquids that have low boiling and melting points.They have weak intermolecular forces between the molecules. These are broken in boiling or melting, not the covalent bonds.
- Ionic compounds:
  - Strong electrostatic forces of attraction between oppositely charged ions
  - Requires a lot of energy to overcome these forces of attraction
  - Therefore, the compounds have high melting and boiling points