AQA GCSE Chemistry

Topic 2: Bonding, structure, and the properties of matter

Chemical bonds, ionic, covalent and metallic

Notes
(Content in bold is for Higher Tier only)
Chemical bonds
- **Compounds**: substances in which 2 or more elements are chemically combined.
- There are 3 types of strong chemical bonds: ionic, covalent and metallic.
  - **Ionic**
    - Particles are oppositely charged ions, which are electrostatically attracted
    - Occurs in compounds formed from metals combined with non-metals
  - **Covalent**
    - Particles are atoms which share pairs of electrons. there is electrostatic attraction between nucleus of atoms and the shared pair of electrons
    - Occurs in most non-metallic elements and in compounds of non-metals
  - **Metallic**
    - Particles are atoms which share delocalised electrons.
    - metallic bonds are strong electrostatic attraction between positive metal ions and delocalised electrons
    - Occurs in metallic elements and alloys

Ionic bonding
- **Metal + Non-metal**: electrons in the outer shell of the metal atom are transferred
  - Metal atoms lose electrons to become positively charged ions
  - Non-metal atoms gain electrons to become negatively charged ions
  - NB: Ions – Atoms that have lost or gained electron/electrons.
- Ions produced by metals in Groups 1 and 2 and by non-metals in Groups 6 and 7 have the electronic structure of a noble gas (Group 0), meaning they have a full outer shell of 8 electrons
- Electron transfer during the formation of an ionic compound can be represented by a dot and cross diagram (see eg for NaCl below)

Make sure you remember to:
- Use arrow to show electron moving
- Add charges on ions
- Draw square brackets on ions
**Ionic compounds**
- A giant lattice structure of ions.
- Held together by strong electrostatic forces of attraction between oppositely charged ions.
- The forces act in all directions in the lattice, and this is called ionic bonding.

An example is sodium chloride (salt):
can be drawn either as diagram below or to the right
diagram below: Na+ (small blue particles) and Cl- (larger green ones)

Different ways of showing ionic or covalent bonding/structure:
- **Dot and cross diagrams:** fine for showing the electronic structure of the ions in a crystal lattice of an ionic compound, but cannot show how the ions are arranged.
- **2D diagram:** gives a limited view of how the ions are arranged in the crystal and doesn’t show any detail of how the ions were formed in making the ionic bond.
- **3D diagram:** doesn’t show any detail of how the ions were formed in making the ionic bond but does show how the ions are arranged.

**Covalent bonding**
- When atoms share pairs of electrons, they form covalent bonds. These bonds between atoms are strong.
- Some covalently bonded compounds consist of small molecules e.g. HCl, H₂, O₂, Cl₂, NH₃, CH₄.
- Some have very large molecules, such as polymers.
- Some have giant covalent structures (macromolecules) e.g diamond, silicon dioxide.
- To show covalent bonding you can draw: dot and cross diagrams, repeat units for polymers, ball and stick and two- and three-dimensional diagrams e.g:
**Metallic bonding**

- Metals consist of giant structures of atoms arranged in a regular pattern.
- 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.