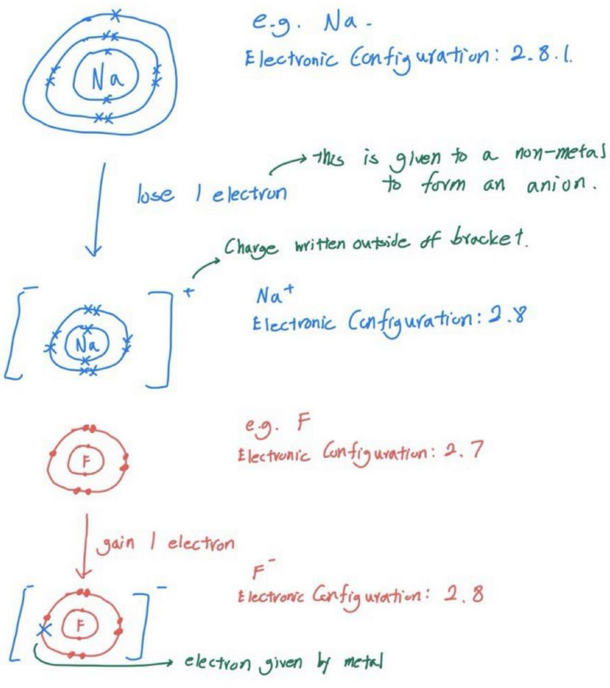
Recap: Atoms do bonding to achieve stable octet electronic configuration

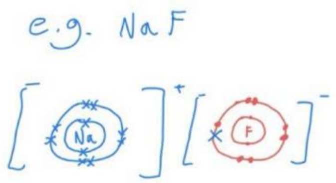
- Atoms either do ionic bonding -> Lose/Gain electrons to form ions
- Or atoms do covalent bonding -> share electrons

Ionic bonding

- Between metal & non-metal
- Metals generally lose electrons, and non-metals generally gain electrons
- Hint: Refer to Periodic Table to determine charge
- Group 1: +1 charge
- Group 2: +2 charge
- Group 3: +3 charge
- Group 4: +4 charge (not commonly tested)
- Group 5: -3 charge
- Group 6: -2 charge
- Group 7: -1 charge
- Group 8: 0 charge (mostly does not form ions)

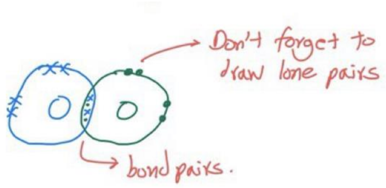
How to draw ionic bonding dot and cross diagram





Covalent Bonding

- Non-metal + Non-Metal
- Sharing of electrons



- Electronic Configuration of O: 2.6
    - 6 valence electrons
    - Needs 2 more electrons
- If 2 electrons are given from each O atom, they can share them, allowing them to each attain stable octet electronic configuration (8 electrons)

For Structure and Bonding, follow this structure when answering:

(Molecule/Compound/Atom) exists as a (Structure) with (Main Bonding/Force) between (molecule/atoms/ions), (explaining with relation to physical/chemical properties)

Simple Molecular Structure

Main Forces -> Intermolecular Forces of attraction between molecules

Properties

- Low mp/bp -> Little energy req to overcome the weak intermolecular forces of attraction
- Non-Conductor of Electricity in **any state** -> e^- localised in covalent bonds -> not mobile to conduct electricity

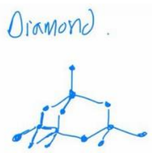
Sample Qn: Explain why O_2 has a low boiling point

Sample Ans: O_2 exists as a simple molecular structure, with weak intermolecular forces of attraction between the O_2 molecules. Little energy is required to overcome the weak intermolecular forces of attraction, thus it has a low boiling point.

Giant Molecular Structure

Main Bonding -> Covalent Bond between atoms

Common Examples: Diamond (C), Graphite (C), Si, SiO_2

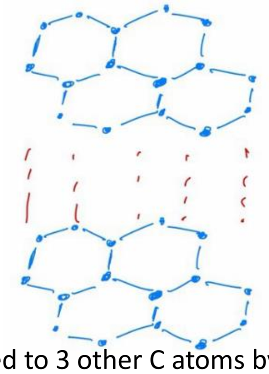


Properties

- High mp/bp -> Large amount of energy required to break strong covalent bonds between atoms
- Non-Conductor of Electricity in any state -> e^- localised in covalent bonds -> not mobile to conduct electricity
- Very insoluble in polar and non-polar solvents -> strong covalent bonds are too strong to break, no interaction can compensate for energy needed to break bond
- Hard, Strong and Non-Malleable -> Strong Covalent Bonds

Graphite

Special Structure with layers of atoms held together by strong covalent bonds.



Structure

- Each C atom bonded to 3 other C atoms by strong covalent bonds, creating layers of C atoms. Each C atom has 1 extra e^- that is delocalised
- Intermolecular forces btwn layers of C atoms

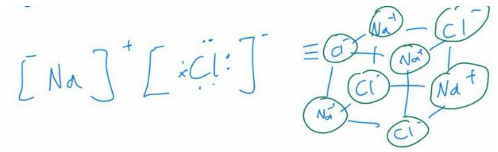
Special properties of Graphite

- Conductor of electricity -> Structure means each C has a delocalised e^- that act as mobile charge carriers
- Soft and Slippery -> Weak intermolecular forces btwn layers of C atom -> Layers can slide over one another easily

Ionic Bonding

Structure -> Giant Ionic Lattice

Main Force -> Strong EFOA between the oppositely charged ions (Name these!)



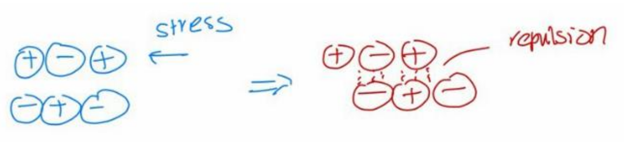
Factors affecting strength of ionic bond

- Look at Lattice Energy (LE)
- LE: energy formed when 1 mol of solid ionic compound is formed from its constituent gaseous ions
- E.g. $K^+(g) + Br^-(g) \rightarrow KBr(s)$

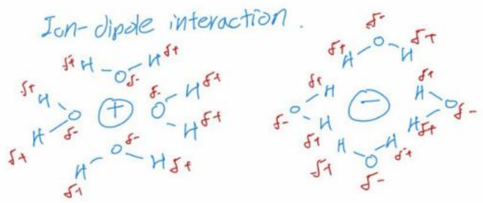
$$\text{lattice energy} = |\Delta H_{latt}| \propto \left| \frac{q^+ \times q^-}{r_+ + r_-} \right|$$

Properties of Ionic Bonding

- High mp/bp -> Large amt of energy req to overcome strong EFOA btwn ions
- Strong and hard -> Strong EFOA
- Brittle -> lattice structure alternates btwn oppositely charged ions -> sliding of layers of ions leads to repulsion -> breaking of ionic lattice



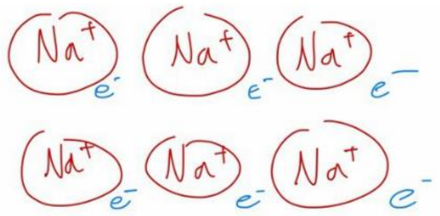
- Non-conductor of electricity in solid state -> Ions in fixed position in lattice structure -> no mobile charge carriers
- Conductor of Electricity in molten/aqueous state -> Ions mobile to act as mobile charge carriers
- Soluble in polar solvents -> Form favourable ion-dipole interactions btwn ion and water molecules



Metallic Bonding

Structure -> Giant Metallic Lattice

Main force -> Strong EFOA btwn Metal Cation and sea of delocalised e^-



Factors affecting strength of metallic bond

- Charge Density

$$\text{Charge Density} = \frac{q^+}{r_+}$$

Properties of Metals

- High mp/bp -> A lot of energy req to overcome strong EFOA btwn metal cations and sea of delocalised e^-
- Good conductor of electricity in solid and liquid states -> Sea of delocalised e^- act as mobile charge carriers
- Malleable/Ductile -> Stress can be applied to cause layers of metal cations to slide

Alloy

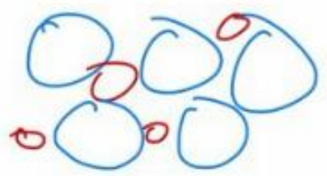
A mixture of metals and one or more elements (e.g. steel contains mainly iron together with carbon and small amounts of other elements)

Properties of Alloys compared to pure metals :

- Harder & Stronger
- Better in Appearance
- Lower in Melting Point
- More Resistant to Corrosion

Qn: Why are alloys stronger and harder/less malleable than pure metals?

Ans: Formation of Alloys -> Different elements can be combined in the layers -> prevents sliding of atoms = alloy stronger



Difference between Elements, Compounds and Mixtures

Element: Contains only one type of atom, Cannot be broken down into a simpler type of matter chemically or physically. E.g. He, O_2

Compound: Contains atoms of 2 or more different elements bonded together, can be chemically broken down into elements. E.g. NaF, CO_2

Mixture: Contains 2 or more elements and/or compounds mixed together, can be physically separated into components. E.g. Alloy, Air