IONIC Bonds

DEFINITION

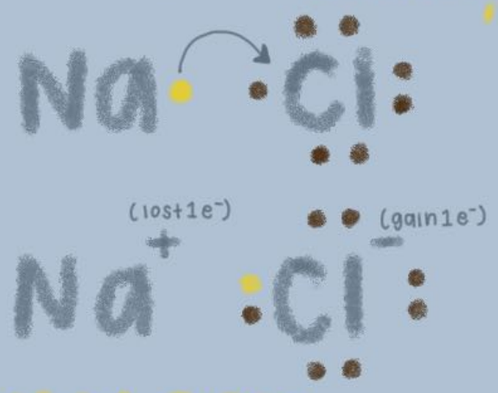
Ionic bonding involves a complete transfer of valence electrons between the bonding atoms

↳ It generates two oppositely charged ions
- The ELECTRON DONOR, usually a metal, loses electrons, forming positively charged CATION
- The ELECTRON ACCEPTOR, usually a nonmetal, gains electrons, forming negatively charged ANION
- The charges of the cation and anion represent the number of electrons lost and gained, respectively (i.e. Mg^{2+} means the magnesium ion lost 2 electrons)

↳ The atoms want to achieve noble gas electron configuration to satisfy the OCTET RULE, so valence electrons are gained or lost based on this concept to obtain the complete outer shell

example halogens in Group 7A will accept 1 valence electron since they have 7 valence electrons :Cl·

drawing of IONIC BONDING



ANALOGY

Ionic bonding is similar to Elizabeth Bennet and Mr. Darcy from *Pride and Prejudice* by Jane Austen. Elizabeth and Mr. Darcy have opposite personalities and a strong relationship by the end of the novel. They "complete" each other, for example Mr. Darcy is very quiet and needs someone who does not just see him for his money, and Elizabeth seeks someone who allows her to be independent, just like nonmetals need valence electrons while metals need to give them away

PROPERTIES

Boiling/Freezing Point high boiling/melting, low freezing due to needing great amounts of energy to overcome bonding electrostatic forces to change states of matter.
Structure regular, lattice, forces acting in all directions
Electronegativity & Strength strongest bond with largest difference in electronegativity of elements > 1.67
Conductivity solid forms are insulators and liquids conductors
Hardness & Malleability/Ductility very hard due to lattice structure, not malleable/ductile, very brittle, soluble in polar solvents

COVALENT NONPOLAR Bonds

DEFINITION

Covalent bonding involves sharing of electron pairs between atoms that are bonding. The atoms involved in the bond have similar electronegativity values, and are usually nonmetals

NONPOLAR COVALENT BONDS are bonds between two atoms with really similar values of electronegativity with a difference of less than 0.4 (very, very low bond polarity, hence the name nonpolar covalent bonding)

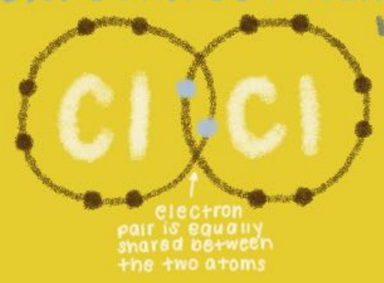
↳ They are often formed between two atoms of the same element to form a diatomic molecule

↳ Electrons are shared equally between the atoms, meaning no dipole moment

example N_2, or the diatomic nitrogen molecule, is a nonpolar covalently bonded molecule because the two nitrogen atoms have same electronegativity values of about 3.04, so they share electrons equally

↳ The bonds have no charges unlike ionic compounds

drawing of NONPOLAR COVALENT



ANALOGY

Nonpolar covalent bonds can be compared to the Dashwood sisters and their husbands in Jane Austen's *Sense and Sensibility*. Elinor and Marianne Dashwood and their husbands are similar in their emphasis on morals and good character, and when Elinor marries Edward and Marianne marries Colonel Brandon, their marriages are equal in that there is no exploitation or complete dependence, like equally shared e⁻s

PROPERTIES

Physical State mainly exist as gases, and some as liquids also very soft in nature
Solubility insoluble in water and other polar solvents, soluble in nonpolar solvents such as CCl_4 and $CHCl_3$
Conductivity insulators, uncharged particles
Boiling & Melting Point very low boiling/melting point, lower freezing point than ionic bonds ← weakest bond
Strength, Malleability, & Ductility most nonpolar covalent molecules are not solids, but when solid, unmalleable & unductile

COVALENT POLAR bonds

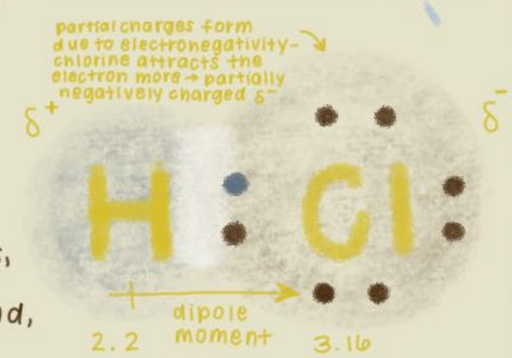
DEFINITION

Polar covalent bonding is another type of covalent bonding where electron pairs are shared between the bonding nonmetal atoms:

↳ Also in nonpolar covalent bonds, there are three types of shared electron pair bonds
- *Single bonds* are bonds made up of one electron pair, has longest bond length
- *Double bonds* are bonds made up of two electron pairs, they are stronger than single bonds, but weaker than triple bonds, (higher bond energy than single, lower than triple), shorter bond length than single bond, but longer than a triple bond
- *Triple bonds* are bonds that are made up of three electron pairs, also the strongest bond order with the highest bond energy, and the shortest bond length

↳ Polar covalent bonds involve atoms with an electronegative difference > 0.4 and < 1.67

drawing of POLAR COVALENT



ANALOGY

Polar covalent bonding can be compared to the relationship between Caderousse, Danglars, and Mondego in *The Count of Monte Cristo* by Alexandre Dumas because the three men are joined by hatred and jealousy towards Edmond Dantès, but Danglars and Mondego reap all the benefits of their scheme, & Caderousse gets much less, like the less electronegative atom gets less electrons

PROPERTIES

Physical State can be solid, liquid, or gas
Melting & Boiling Point Higher melting and boiling points than nonpolar covalent bonds, and higher freezing point as well, stronger than nonpolar
Conductivity conduct electricity in the solution state due to mobility of partial charges
Solubility, Malleability & Ductility highly soluble in polar solvents such as water, unmalleable & unductile due to formation of network covalent solids

METALLIC bonds

DEFINITION

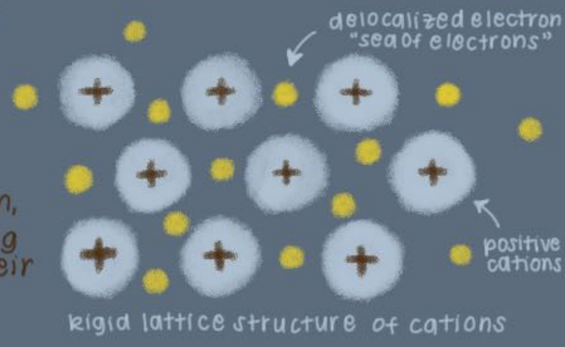
Metallic bonding occurs when delocalized electron in a sea of electrons are collectively shared, and the electrons move throughout a metal atom positive cation lattice that is fixed and rigid

The STRENGTH of the bond depends on
↳ Total number of delocalized electrons
↳ Magnitude of positive charge of metal cation
↳ Ionic radius of the cation

When metallic compounds are heated and molten, the bonds are not broken, just weakened, causing the ordered array of metal ions to lose their definite, rigid structure and become liquid
The bonds completely break at boiling point

↳ Metallic bonding can occur between atoms of the same element or different elements to form alloys
- INTERSTITIAL ALLOY when a much smaller element fills the space between cations of the base element (much larger atomic radii) making the compound stronger
- SUBSTITUTIONAL ALLOY when an atom of similar atomic radius substitutes some of the base element atoms in the lattice

drawing of METALLIC BONDS



ANALOGY

Metallic bonding is analogous to Julia and Winston's relationship in 1984 by George Orwell because they were connected by a common ideology (to rebel against the totalitarian system), similar to the sea of electrons, rather than giving or accepting anything their bond was very strong because of this, and did not break in the face of obstacles, only weakening but maintaining the connecting thought process, only breaking after the punishment went too far, like the boiling point of a metallic bond

PROPERTIES

Conductivity The mobile electrons conduct electricity
Thermal Also transfers heat because e⁻ transfer kinetic energy
Malleability & Ductility yes for both, can be flattened & pulled into wire
Metallic Luster The electrons absorb photons, making the luster
High Melting & Boiling The attractive force is strong, especially high boiling (only weaker than ionic)

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