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Notes on Bonding

4.1: Ionic Bonding

4.1.1: Describe the ionic bond as the electrostatic attraction between oppositely charged ions:

The ionic bond is an attraction between the positively charged cat-ion (which loses its valence electron(s)) and the negatively charged anion (which gains electron(s)).

4.1.2: Describe how ions are formed through electron transfer:

When electrons transfer, the cat-ion is formed by the donating species (usually the metal), and the anion is created by the receiving atom (usually the non-metal)

-All ions are electrically neutral, the ionic charge is determined by the number of electrons gained or lost by the species.

4.1.3 & 4.1.4: Deduce the ions formed by elements in groups 1🡪 0

-Metals in groups 1-3 form cat-ions.

-Elements in group 4 do not form ionic bonds because their number of valence electrons (4) is **equidistant from both stable octets** (the one formed by losing all valence electrons, and the one formed by gaining a sufficient number of electrons from another atom).

-Elements in groups 5-7 form anions because their number of valence electrons is above 4 and thus they more easily gain electrons than lose them.

-The noble gases in group 0 do not form ions because they have a stable octet.

4.1.5: State that transition elements can form more than one ion (plus explanation)

-Transition metals have unusual electron configuration that give way to multiple oxidation states.

-The iron atom can form both by losing two electrons or

-Different ions of transition elements form compounds that have different colors. These color changes can be used to identify different elements.

4.1.6: Predict whether a compound of two elements would be ionic from their position of elements in the Periodic Table or from their electronegativity values:

-If the difference in electronegativity’s of two atoms is greater than 1.8, then the bond formed between them is considered to be ionic.

-The **ionic character** of a compound is determined by the electronegative difference as well. The higher the difference, the higher the ionic character.

-Recall that the reactivity of metals increases going down the group, and the reactivity of non-metals (halogens) decreases down the group.

-Given several possible potential compounds, the ionic character will be greatest between elements that have the greatest diagonal distance from each other.

-Thus in theory, Francium Flouride would be the most ionic compound, and Lithium Astantide would have the least ionic character (both of these compounds involve the most reactive halogen and most reactive alkali metal, and least reactive alkali metal and halogens respectively).

4.1.7: State formulas of polyatomic ions formed by non-metals in periods two and three

PO33- (phosphite) PO43- (phosphate) PO23-  (hypophosphite)

HPO42-  (hydrogen phosphate) HPO32- (hydrogen phosphite) H2PO3-  (Dihydrogen Phosphite)

H2PO4-  (dihydrogen phosphate) SO32- (sulfite) SO42-  (sulfate) HSO3-  (hydrogen sulfite)

HSO4-  (hydrogen sulfate) ClO-  (hypochlorite) ClO2-  (chlorite) ClO3-  (chlorite)

ClO4-  (perchlorate) CO32-  (carbonate) HCO3- (hydrogen carbonate) NO2-  (nitrite)

NO3-  (nitrate) NH4+  (ammonium)

FO-  (Fluorate; never detected: assume same pattern as Chlorine polyatomic ions)]

4.1.8: Describe the lattice structure of ionic compounds

The lattice structure of ionic compounds is arranged so that every single anion is completely surrounded by cat-ions, and every cat-ion is completely surrounded by anions. The chemical formulas of ionic compounds are merely a representation of the ratio of cat-ions to anions and vice versa.

4.4: Metallic Bonding

4.4.1: Describe the metallic bond as the electrostatic attraction between a lattice of positive ions and delocalized electrons.

The lattice structure of a metallic bond is a group of positively charged ions surrounded by a “sea” or group of delocalized electrons that are said to have a **completely random** path of travel.

4.4.2: Explain the electrical conductivity and malleability of metals:

Metals conduct electricity because the highly mobile electrons can travel through the body of the entire metal in response to voltage.

Because the movement of the electrons is completely random, the application of pressure does not change the constitution of the metal, thus metals are malleable (they are also ductile [can be made into wires] for this reason).