Chemical Bonding

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looking at bonding and nobel gases

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1 Compounds

DEFINITION

Compounds.

A substance made up of two or more elements chemically combined.

An example:

EXAMPLE 1.1

$$2\,H_{2(g)} + O_{2(g)} \longrightarrow 2\,H_2O_{(l)}$$

Nobel gas: Very stable and nonreactive. He and Ne never form compounds.
Uses: Helium: weather balloons and blimps, not flammable. Argon: electric light bulbs to prevent tungsten filament from evaporating or reacting with air.
We want to create stable compounds in chemistry. The way we do that is by having 8 electrons in the outer shell.

DEFINITION

Octet Rule.

When binding occurs, atoms tend to reach an electron arrangement with 8 electrons in the outermost energy level.

Exceptions: - Transition metals - can have more or fewer than 8 electron in outermost energy level - Elements near helium - tend to have 2 electron in outer energy level rather than 8 in the nobel gases.

DEFINITION

Valence Shell.

The outermost energy level is also known as the valence shell.

2 Ionic binding

DEFINITION

Ionic Bonding.

An ionic bond is the electrostatic force of attraction between oppositely charged ions in a compound.

Make sure you have 'electrostatic force' in it. That is what causes the bond

DEFINITION **Ion.**

A charged atom or group of atoms.

Looks at the losing and gaining of electron to form compounds. Also known as transfer of electrons. Mainly between metals and non metals usually quite stable looking a lot at crystal structures.
Example
Aliminium. 3 electrons in outermost shell It will loose 3 because it's less energy to loose 3 than gain 5.
the rule of thumb less than four, it losses, more then four it gains, 4, it does either.

3 Valency

DEFINITION **Valency.**

The number of bonds an atom of the element forms when it reacts.

Valency is the same column number as the element is in on the periodic table. if it is positive, it will loose, negative it will gain
+1,+2,+3,+-4, -3, -2, -1
table of group, electron sin outer shell, electron to be lost/gained, valency group: 1,2,3,4,5,6,7,8
Electron in outer shell: 1 e-, 2e-, ...

DEFINITION **Cation.**

A positively charged ion. Attracted to a cathode in electrolysis

DEFINITION **Anion.**

A negatively charged ion, Attracted to an anode in electrolysis,

4 Crystal Lattice Structures

Ionic bonds result in a crystal lattuice structure.
Called the unit cell, wich repeats iself in all directions, up and down.
We look at this structure as it tells us the property of ionic compounds.
Ionic compounds have high boiling points., beacuse of this crystal lattice structure, the bonds are very strong.

5 Uses of ionic compounds

- Sodium chloride - To preserve and flavour food
- Brine is used to cure bacon
- Flouridation of water supplies to prevent tooth decay

6 Writing chemical formulas

6.1 Steps

- Symbol of posiitive ion goes first
  - Check valency of ions
  - Find the lowest common multiple between the iosn to help balance the molecule
  - Write equations
- Use subscripts

6.2 Example 1

Writing the chemical formula for alluminium oxide
YOu get the elemnts you use for the name
Alluminum = Al Oxygen = O
Check their valency
Alluminum - group 3, +3 valency Oxygen - group 6, -2 valency
Al^{3+} O^{2-}.
Finding the LCM of 2 and 3, 6 The formula can be balanced by dividing the LCM by the valency.
Al_2O_3

6.3 Example 2

Sodium Sulfate
Sodium = Na, group 1, valency = +1
Sulphate = SO_4^{2-}
LCM = 2

$$Na_2SO_4$$

6.4 Transition Metals Example

Trnsition metals have variable valency. IN teh exam, they will give you the valency.

6.5 Chemical Equation

Chemical equation describe sa chemical change
Rectant Reaction Symbol Product
2Ag + h2s ————–> Ag2
Reactant to product

6.6 Subsctipts and Coefficients

Subscripts Shows hwo many atoms of an element are in a modelcule
Example: H_2 O means 2 atoms of hydrogen

Coeffieienct Shows how many molecules there are of a particular chemical
Example: 3H_2 O - means there are 3 water molecules

6.7 Conservation of Mass

DEFINITION

Law of Conservation of Mass.

The total mass of the products of a chemical reaction is the same as the total mass of the reactants.

If we obey this principle, the equations will stay balanced

6.8 Conservation of Matter

DEFINITION

Law of Conservation of Matter.

In any chemical reaction, matter is neither created nor destroyed, but vhanged from one (BLANK) to another.

6.9 Balancing Equations

They will give you an equation for you to check is balanced.
Example:
Zn + HCl –> ZnCl_2 + H_2
note the number of atoms in the left and right:
left: 1 Zn, 1 H, 1 CL
Right: 1 Zn, 2H, 2Cl
This equation is therefor not balanced.
to balanace this equation, you cannot change the subscript, but you can change the coefficients.
Start with the buggest and work down.
Zinc is balanced, so move to chlorene. You can see that we will need to add another HCL to the left.
left: 1Zn, 2H, 2Cl
right: 1Zn, 2H, 2Cl
Thus the equation is balanced.

6.10 Covalent Bonding

A covenant bond is a shared pair of electrons.

- A single bond has a 1 shared pair of electrons
  - Sigma bond, σ
  - H – H
- A double bond has 2 shared pairs of electrons
  - Pi bond, π
  - O = O
- A triple bond has 3 shared pairs of electrons
  - Made up of sigma and pi bonds
  - $\mathrm{N} \equiv \mathrm{N}$

While ionic bringind only takes place between metals and non-metals, covalent bonds are typical of non-metal elements.

6.10.1 Sigma Bonds

Formed by the head-on overlap of two orbitals.
These binds are stronger.
In a covalent single bond, it is a sigma bond,however, in a double or triple bond there is 1 sigma bond and the others are pi bonds.

6.10.2 Pi bonds

Formed by the sideways overlap of p orbitals
THROW IN DEM DIAGRAMS

6.10.3 Polar and Non-Polar Covalent Bonding

You can have two types of bonding.
Non polar covalent compounds are usually bonds between the same atom.
Example: H_2 contains only one type of atom so the nuclei attract the electrons in the same way. This means the electrons are equally shared. This is called a non-polar bond.
Most covanelt bonds are tdiferne tatoms bneonded togehter so the shared electrons are attracted differently based on two factors.

1. Smaller atoms have a stronger attraction than larger ones because they can get closer to the shared electrons
2. Atoms with bigger charge in teh nuleus will have a greaters attarction.

6.11 Eletronegativity

DEFINITION

Electronegativity.

Electronegativity is the relative attraction of an atom for shared pairs of electrons in a covalent bond

Yioy can yselectronnegativity valyes to predict the nature of bonds.
The greater the differencein electronegativity values between two bonding atoms, the greater the degree of polarity. We an use EN values to pridict the types of bonds:

- 0 - 0.5 = Non polar
- 0.5 - 1.7 = Polar covalent
- $>$ 1.7 = Ionic

7 Shape of covalent compound

To predict the shape of a covalent compund:

1. Draw the lewis diagram
2. Pick the central element. It is the element with only one atom or the highest valency.

3. Check lp and bp for central atom

Example: LEWIS STRUCTURE OF CH_4
There is 0lp and 4 bp

8 Valence Shell Electron Pair Repulsion Theory (VESPR Theory)

The shape of a molecule depends on the number of pairs of electrons around the central atom. Electrons are negatively charged, pairs repel each other and want to be as far apart as possible.
Lone pairs have a greater repelling force than bonding.
ADD TABLE LIKE https://chem.libretexts.org/Textbook_Maps/Physical_and_Theoretical_Chemistry_T
All bond pairs spread equally. When a lone pair is added, they spread.
This inequality explains how electrons repel eachother in the bond.
Repelling power:
$lplp > lpbp > bpbp$
Lone pair electrons have a greater repelling effect compared to bond pair electrons, disturbing the bond angle.

9 Shape and Polarity

Symmetry can also have an eeffect on the polarity of a molecule
We need to be able to look at where the center of negative and positive charg lies.
Non-polar molecules have the centre of the positive and negative charges in one location.
THere isn an equal pull on the eˆ- even though the individual bonds may be polar.
Examples: CH_4, BF_3, BeH_2

9.1 Symetry and Polarity in Molecules

Polar molecules have a center of positive charge seperated from the centre of the negative charge
Even though the individial bonds may be non-polar, the overall molecule is polar
Example: NH_3 and H_2O