*COVALENT BONDS*

The sharing of bonds is done by pairing up valence e-.
STRUCTURAL formulas - show arrangements of molecules and ions. ex. H--H $H_2$ (empirical)
pair of e-

Single Covalent Bond: 1 pair of e- shared between two atoms. ex. H + H ----> H H (electron dot notation)

BRINClHOF - Elements that exist as diatomic compounds have covalent bonding.

F + F -------> F F or F--F

.. = unshared pair of e-

According to the octet rule, GROUP 6 elements will want to form a Double Covalent Bonds. (2 shared pairs of e-) ex. O

O O
(stronger bonding)
Triple Covalent Bond: It has 3 pairs of shared e-. (group 5)

N N :N::N: :N N:
COVALENT COMPOUNDS

Electron dot formulas for molecules of compounds can be written.

ex. ammonia $NH_3$

H
H + N ------->
H

carbon dioxide $CO_2$

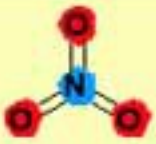
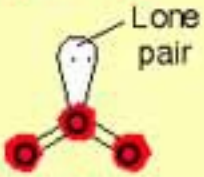
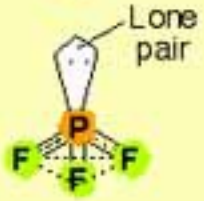
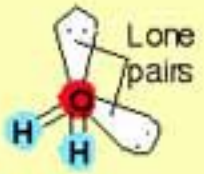
C + O
----------> :O C O:
O

VALENCE SHELL ELECTRON-PAIR REPULSION THEORY (VSEPR)
-using bond angle and geometric shapes to describe the type of covalent bonding present in a molecule

When e-prs. repel, molecules will adjust their shapes so that the pairs are as far apart as possible.

ex. $CH_4$
Unshared e- prs. will repel strongly from paired e-. The unshared will push the shared together.

ex. $NH_3$

| Electron Groups | | | Arrangement of Groups | Molecular Shape | Example | |
|---|---|---|---|---|---|---|
| Total | Bonding | Lone | | | | |
| 2 | 2 | 0 | Linear | Linear | $CO_2$ |  |
| 3 | 3 | 0 | Trigonal planar | Trigonal planar | $NO_3^-$ |  |
| | 2 | 1 | | Bent (or angular) | $O_3$ |   |
| 4 | 4 | 0 | Tetrahedral | Tetrahedral | $CH_4$ |  |
| | 3 | 1 | | Trigonal pyramidal | $PF_3$ |   |
| | 2 | 2 | | Bent (or angular) | $H_2O$ |   |

Exceptions to VSEPR or octet rule:
ex. B, S, and P (When they are the central atom, they may not fulfill the octet rule)
B - < 8
S, P - > 8

RESONANCE: two or more equally valid e-dot structures can be written for a molecule.
ex. $O_3$ ozone
EXCEPTIONS TO OCTET RULE

$NO_2$ (17 e-)

Why is it an exception?
because it has a lone electron due to the magnetic effect.

ELECTRIC CHARGES ON ELECTRONS
Magnetic effect - electrons spinning in opposite directions (↑↓) - cancel each other

paired e- DIAMAGNETIC (even number of e-)
unpaired e- PARAMAGNETIC ( odd number of e-)

If electrons have a paramagnetic spin, then they have a strong attraction to an external magnetic field, not internal.

COORDINATE COVALENT BONDS

This bond is formed when an atom contributes BOTH BONDING E-. It's indicated by an arrow pointing to the atom which has nothing to contribute.

-Occurs in almost all polyatomic ions

ex. $NH_4^{+1}$

$H^{+1}$ +

POLARITY

NON POLAR COVALENT BOND - Diatomic elements will form a bond where e- are shared equally. ex. $F_2$

POLAR COVALENT BOND - When 2 different atoms are joined by a bond and e- are not shared equally.

*The higher the electronegativity value, the greater the ability for an atom to attract e- to itself.*

SHOW POLARITY

δ --> represents a partial charge

Which is more electronegative? p.151 or trend?

$CH_4$

Consult a reference table (similar to p. ) to find out how polar the bond is: moderately polar covalent

| Bond type | Electronegativity difference |
|---|---|
| Nonpolar covalent | 0-0.4 |
| Moderately polar covalent | 0.4-1.0 |
| Very polar covalent | 1.0-2.0 |
| Ionic | >2.0 |

POLAR MOLECULES: One end of the bond is negative and one end is positive

*Dipole* - 2 poles (charged regions)

Linear molecules - bond polarities cancel each other (opposite directions)

ex. $CO_2$

Bent - polarities don't cancel

ex. $H_2O$

INTERMOLECULAR ATTRACTIONS

-responsible for the physical state of a molecular compound (S, L, G)

FORCES OF ATTRACTION INCLUDE:

1. Van Der Waals - weakest attractions;

2 kinds

a. dispersion forces - caused by motion of e-

These forces increase as the number of e- increase. ex. Halogens (change of state as you go down a group)

b. dipole interactions - electrostatic attractions between poles (+, -) ex. $H_2O$

liquid - weak intermolecular attraction

solid - strong " " "

2. Hydrogen bonding - strongest intermolecular force;

found in proteins

-usually 1 or more prs. of unshared e- exist around the central atom.

DIFFERENCES BETWEEN IONIC AND COVALENT COMPOUNDS

| **Characteristics** | **Ionic compound** | **Covalent compound** |
|---|---|---|
| Representative unit | Formula unit | Molecule |
| Bond formation | Transfer between one or more electrons between atoms | Sharing of electron pairs between atoms |
| Type of elements | Metallic and nonmetallic | Nonmetallic |
| Physical State | Solid | Solid, Liquid, or Gas |
| Melting Points | High (usually above 300 C) | Low (usually below 300 C) |
| Solubility in water | Usually high | High to Low |
| Electrical conductivity of aqueous solution | Good conductor | Poor to nonconducting |