LEWIS ELECTRON DOTS (1916, G.N.Lewis)

- ♥ dots are used to represent the number of electrons in outermost s and p orbitals
- ♥ dots are written in pairs on each side of the atomic symbol (symbol represents the nucleus and inner shells of electrons)

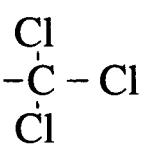
eg.	F	$1s^2\underline{2s^2 2p^5}$	7 valence electrons	:F:
	Cl	$1s^2 2s^2 2p^6 \underline{3s^2 3p^5}$	7 valence electrons	:Cl:
	N	$1s^2\underline{2s^2 2p^3}$	5 valence electrons	:N.

- ♥ Octet Rule:
  - ☺ most bonded non-metallic elements have atoms with 8 electrons in their outermost energy levels.
  - ☺ exceptions exist (H only has 2 eg. H:H)

- ♥ To determine the bonding of a molecule:
  a) determine the bonding experimentally
  b) make an assumption

either: a) if formula has the form AX_n (one atom of one element and several of another) assume that the single atom is in the middle with the others surrounding it.

eg. CCl_4



or b) molecules will form the most symmetrical shape

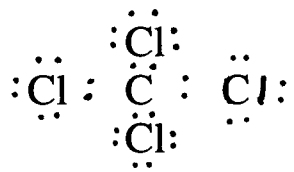
eg. H_2O_2 H-O-O-H

♥ NAS technique:

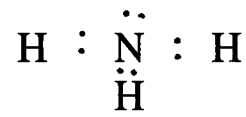
	☺Needed -	how many electrons in total must the atoms share to satisfy the octet rule?
–	☺Available -	what is the total number of valence electrons in all the atoms of the molecule?
=	☺Shared -	how many electrons must be shared?

eg. single bonds

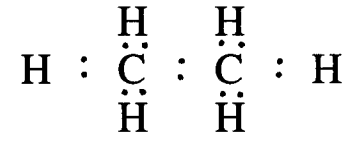
CCl_4
N = 5 x 8 = 40 electrons
A = 1(4) + 4(7) = 32 electrons
S = 40 - 32 = 8 electrons



NH_3
N = 1(8) + 3(2) = 14 electrons
A = 1(5) + 3(1) = 8 electrons
S = 14 - 8 = 6 electrons

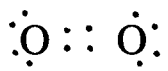


C_2H_6
N = 2(8) + 6(2) = 28 electrons
A = 2(4) + 6(1) = 14 electrons
S = 28 - 14 = 14 electrons

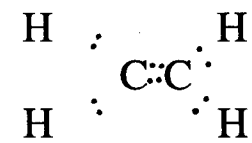


eg. double bonds

O_2
N = 2(8) = 16 electrons
A = 2(6) = 12 electrons
S = 16 - 12 = 4 electrons



C_2H_4
N = 2(8) + 4(2) = 24 electrons
A = 2(4) + 4(1) = 12 electrons
S = 24 - 12 = 12 electrons



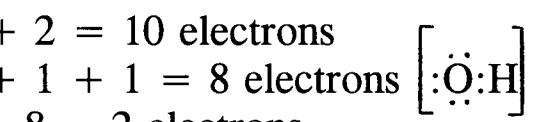
eg. triple bonds

N_2 N = 2(8) = 16 electrons
A = 2(5) = 10 electrons
S = 16 - 10 = 6 electrons

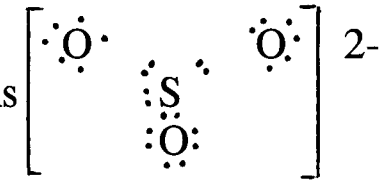
:N:::N:

eg. polyatomic ions

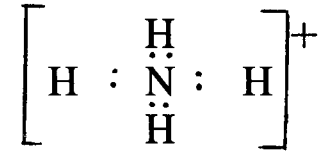
OH^- N = 8 + 2 = 10 electrons
A = 6 + 1 + 1 = 8 electrons
S = 10 - 8 = 2 electrons



SO_3^{2-} N = 4(8) = 32 electrons
A = 4(6) + 2 = 26 electrons
S = 32 - 26 = 6 electrons



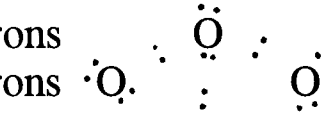
NH_4^+ N = 8 + 4(2) = 16 electrons
A = 5 + 4(1) - 1 = 8 electrons
S = 16 - 8 = 8 electrons

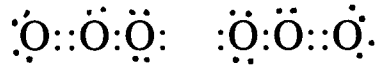


Resonance

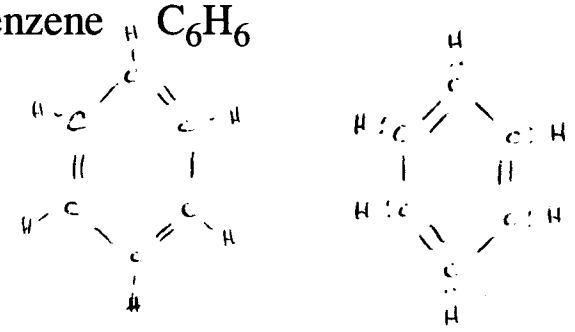
- ♥ one limitation of the electron dot model is that it doesn't explain bonds which are in between single, double and triple bonds.
- ♥ resonance structures are used to represent a molecule when no single electron dot structure adequately depicts the molecule.
- ♥ the structures don't actually exist but if taken together they provide a better representation than any one diagram, the actual molecule is a composite of the different structures

eg. ozone O_3 N = 3(8) = 24 electrons
A = 3(6) = 18 electrons
S = 24 - 18 = 6 electrons



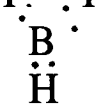


eg. benzene C_6H_6

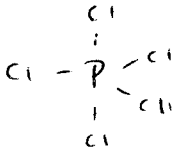


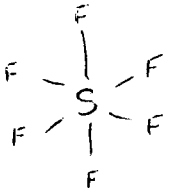
Exceptions

♥ some groups are exceptions to the octet rule. Instead of requiring 8 electrons in their bonded orbitals, they require:

H	2	eg.	H:H	H_2
Be	4	eg.	H:Be:H	BeH_2
B	6	eg.		BH_3

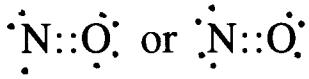
♥ some compounds involve bonding with d orbitals in addition to the s and p orbital electrons.

eg. PCl_5 

SF_6 

♥ some compounds can't be explained using this method and require more sophisticated bonding theories. (see AP Chem)

eg. NO N = 2(8) = 16 electrons
A = 5 + 6 = 11 electrons
S = 16 - 11 = 5 electrons

 or ?