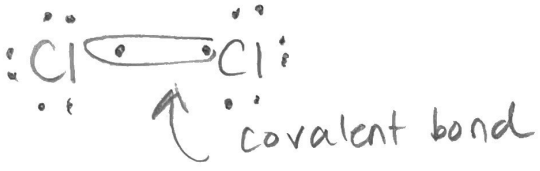
Covalent Bonding and Molecular Compounds

- ✓ Recall: molecular compounds consist of non-metals bonded to other non-metals through covalent bonds (e.g. H_2O, F_2, CH_4, $C_6H_{12}O_6$)

- ✓ What is a covalent bond?
  - o A bond formed between 2 non-metal atoms by sharing a pair of electrons

e.g. H_2

e.g. Cl_2



- ✓ But how do you determine the maximum number of covalent bonds an atom can form?
- ✓ Atoms react with each other because they want to be stable
  - o Acquire 8 valence electrons in their valence shell
  - o This is called the OCTET RULE

- ✓ The maximum number of bonds an atom can form is called its bonding capacity (BC)
  - o It is related to the # of valence electrons
  - o For groups 1 , 2 and 3 BC = group #
  - o For groups 4 to 8 BC = 8 - # of valence electrons
  - o e.g BC for B = 3
    BC for C = 8-4 = 4
    BC for Cl = 8-7 = 1
    BC for O = 8-6 = 2
    BC for H = 1
  - ✓ Note: there are EXCEPTIONS to the general rule
    - o think about electron orbital configurations

Steps for Drawing Lewis Dot Diagrams and Structures for Molecular Compounds

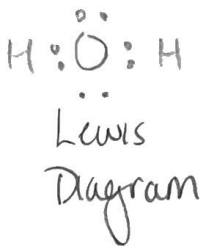
1. Find the total number of valence electrons from all the atoms in the chemical formula - this is called your ELECTRON BANK
2. The central atom is the one that needs the most electrons to complete its octet (usually the has the highest bonding capacity)
3. Arrange the other atoms around the central atom
4. Use one pair of electrons to form a covalent bond between each pair of atoms (use •• to indicate electrons)
5. Arrange the remaining electrons to satisfy the octet rule (or duet rule for hydrogen) for the outer atoms
6. Place any "extra" electrons from the ELECTRON BANK on the central atom
    i. Ensure that the OCTET rule is satisfied for the central atom
    ii. If NOT, then multiple bonds may be necessary (next class)

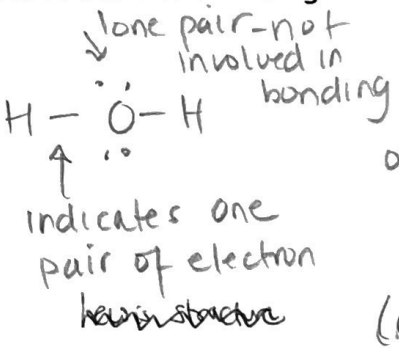
Note: Remember a Hydrogen atom can only make ONE covalent bond!

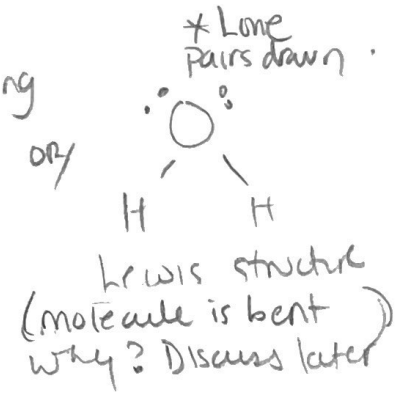
Examples: Draw Lewis Dot diagrams and structures for the following covalent molecules

a) H_2O

O : 6ē
H : 1ē x 2
8ē
- 4ē (bonds)
4e - 4ē = 0 ← lone pairs

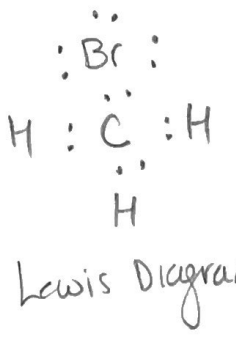


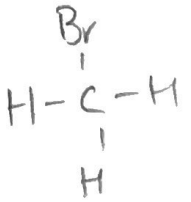




b) CH_3Br

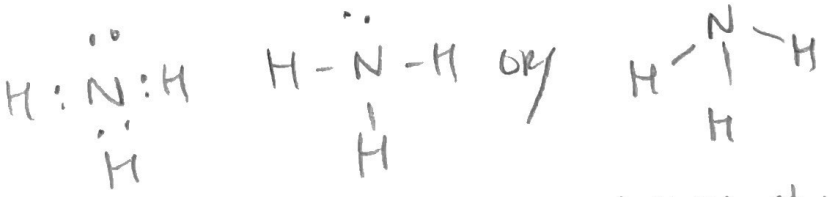
C : 4ē
H : 1ē x 3
Br = 7e
14e
- 8
6ē - 6ē = 0





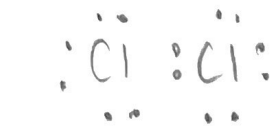
c) NH_3

N · 5ē
H · 1ē x 3
8e
- 6e
2ē - 2ē = 0



d) Cl_2

Cl : 7ē x 2
14 ē
-2ē
12 ē
-12 e
0



Lewis Diagram

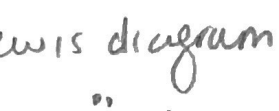
Cl-Cl

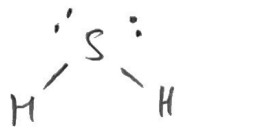
Lewis Structure (molecule is linear)

e) H_2S

S : 6ē
H : 1ē x 2
8 ē
-4ē
4 e
-4e
0ē

Lewis diagram



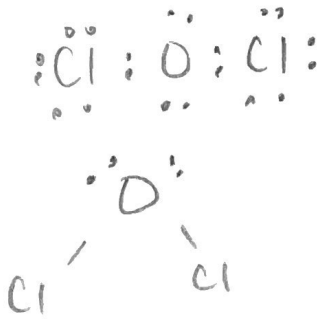


Lewis Structure (Bent)

f) OCl_2

Lewis diagram

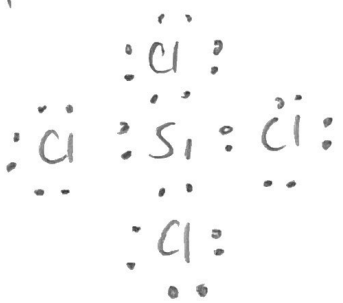
O : 6ē
Cl : 7ē x 2
20ē
-4e
16ē
-12e
4e
-4e
0

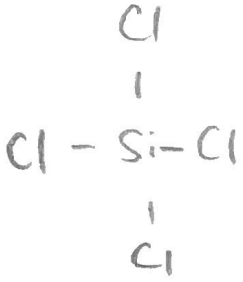


Lewis Structure (Bent)

g) SCl_2 $SiCl_4$

Si : 4e
Cl : 7ē x 4
32 e
-8e
24e
-24e
0ē





Homework

WFT: read pgs 75-77

Try Q#1 on pg 77, Q#2(omit b) on pg 79

Q#5,6,8,11(a,c) on pg 81