NAME:_____

LAB SECTION (check one): ___1 (TuTh@3:30) ___3 (TuTh@9:40)



**Valence Electron Configuration, Bonding & Molecular Polarity Lab Activity**

## VALENCE ELECTRONS, BONDING & MOLECULAR GEOMETRY and POLARITY

REF: *Chemistry, 7th ed.*, Zumdahl & Zumdahl:
sections 7.11, 8.1-8.4, 8.9-8.11, & 8.13
figures 2.22, 7.28 & 8.3
tables 8.1, 8.2 & 8.6
*Basic Lewis Structure Rules, CHM102*, Wallace, Winter 2009

EQUIPMENT: n/a

MATERIALS: n/a

## INTRODUCTION

Macroscopic physical properties such as melting point, viscosity, and vapor pressure are determined by the interactions of microscopic particles (atoms, ions, and/or molecules) in solids and liquids. Interparticle interactions are determined by the nature of the particles. In this exercise, you will examine some simple atoms, ions and molecules in order to understand the types of interactions that we will examine in chapter 10.

## PROCEDURE

1. Identify the type of bonding that occurs between the following pairs of elements as covalent/non-polar (C/NP), polar covalent (P), or ionic (I).

a. C, H 2.5, 2.1, Δ = 0.4 ..... (C/NP) ..... P ..... I

b. C, O 2.5, 3.5, Δ = 1.0 ..... C/NP ..... (P) ..... I

c. Ca, Cl 1.0, 3.5 ..... C/NP ..... P ..... (I)

d. Cl, Cl 3.0, 3.0 ..... (C/NP) ..... P ..... I

e. H, Cl 2.1, 3.5 ..... C/NP ..... (P) ..... I

f. H, Br 2.1, 2.8 ..... C/NP ..... (P) ..... I

g. H, F 2.1, 4.0 ..... C/NP ..... (P) ..... I

h. H, O 2.1, 3.5 ..... C/NP ..... (P) ..... I

i. Li, Cl ~~0~~ 1.0, 3.5 ..... C/NP ..... P ..... (I)

j. Na, Cl 0.9, 3.5 ..... C/NP ..... P ..... (I)

k. N, H 3.0, 2.1 ..... C/NP ..... (P) ..... I

l. N, N 3.0, 3.0 ..... (C/NP) ..... P ..... I

m. Se, O 2.4, 3.5 ..... C/NP ..... (P) ..... I

2. For any of the following covalent bonds that are polar, indicate the polarity with the symbols **δ+** and **δ-**.

a. C – H

b. $\overset{\delta+}{H} - \overset{\delta-}{Cl}$

c. $\overset{\delta+}{H} - \overset{\delta-}{F}$

d. $\overset{\delta+}{C} = \overset{\delta-}{O}$

e. $\overset{\delta-}{N} - \overset{\delta+}{H}$

f. $\overset{\delta+}{C} - \overset{\delta-}{N}$

3. Indicate the number of valence electrons for each of the following elements.

a. C..... 4

b. Cl..... 7

c. F..... 7

d. H..... 1

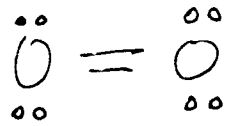
e. Li..... 1

f. N..... 5

g. O..... 6

h. S..... 6

4. Complete the following table. Construct a model for each molecule or polyatomic ion; use the following "atoms" in model kits:
   a. C = black sphere w/ 4 holes; use all 4 holes for bonds
   b. H = white sphere w/ 1 hole
   c. N or P = blue sphere w/ 4 holes; only use 3 holes for bonds
   d. O or Se = yellow sphere w/ 4 holes; only use 2 holes for bonds
   e. F, Cl, or Br = (*any other color*) sphere w/ 4 holes; only use 1 hole for bonds

| **FORMULA** | **SUM of VALENCE ELECTRONS** | **LEWIS STRUCTURE** | **ELECTRON GEOMETRY** | **MOLECULAR GEOMETRY** (*around central atom*) | **POLAR? Y/N** |
|---|---|---|---|---|---|
| $H_2$ | 2 | H—H | X | n/a | N |
| $O_2$ | 12 |  | TRIG. PLAN. | n/a | N |
| $N_2$ | 14 | :N≡N: | LINEAR | n/a | N |

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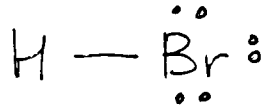
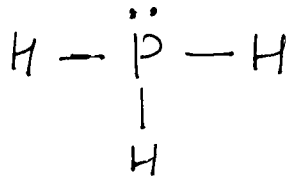
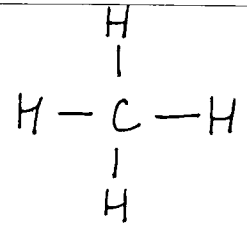
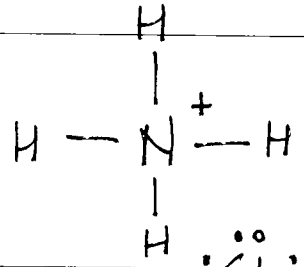
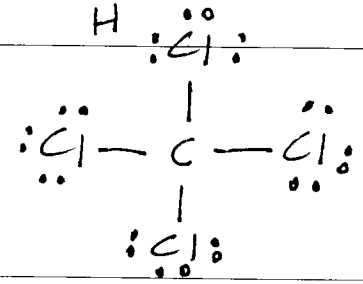
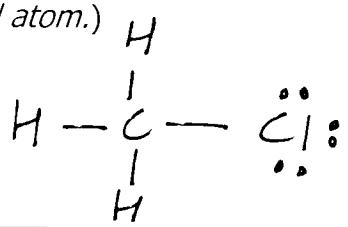
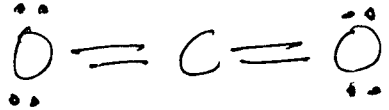
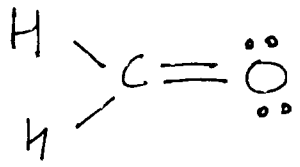
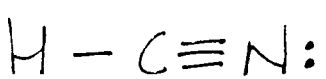
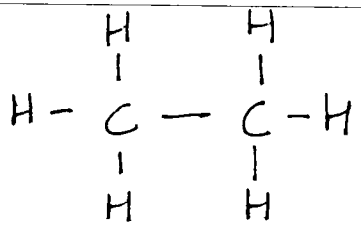
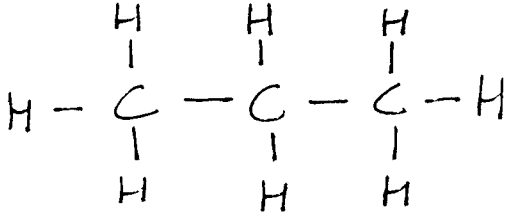
| FORMULA | SUM of VALENCE ELECTRONS | LEWIS STRUCTURE | ELECTRON GEOMETRY | MOLECULAR GEOMETRY (*around central atom*) | POLAR? Y/N |
|---|---|---|---|---|---|
| HBr | 8 |  | TETRA. (*around Br*) | n/a | Y |
| $SeF_2$ | 6 + 2x7 = 20 |  | TETRA. | BENT | Y |
| $PH_3$ | 5 + 3x1 = 8 |  | TETRA. | TRIG. PYRAMIDAL | Y |
| $CH_4$ | 4 + 4x1 = 8 |  | TETRA. | TETRA. | N |

| FORMULA | SUM of VALENCE ELECTRONS | LEWIS STRUCTURE | ELECTRON GEOMETRY | MOLECULAR GEOMETRY (*around central atom*) | POLAR? Y/N |
|---|---|---|---|---|---|
| $NH_4^+$ | $5+4\times1-1$ $=8$ |  | TETRA. | TETRA. | N |
| $CCl_4$ | $4+7\times4$ $=32$ |  | TETRA. | TETRA. | N |
| $CH_3Cl$ | $4+3+7$ $=14$ | (*C is the central atom.*)  | TETRA. | TETRA. | Y |
| $CO_2$ | $4+2\times6$ $=16$ |  | LINEAR | LINEAR | N |

| FORMULA | SUM of VALENCE ELECTRONS | LEWIS STRUCTURE | ELECTRON GEOMETRY | MOLECULAR GEOMETRY (*around central atom*) | POLAR? Y/N |
|---|---|---|---|---|---|
| $H_2CO$ | 2+4+6 = 12 | (*C is the central atom.*)  | TRIG. PLANAR | TRIG. PLANAR | Y |
| HCN | 1+4+5 = 10 | (*C is the central atom.*)  | LINEAR | LINEAR | Y |
| $C_2H_6$ | 2×4 + 6×1 = 14 |  | TETRA. | TETRA. | N |
| $C_3H_8$ | 3×4 + 8×1 = 20 |  | TETRA. | ~~TETRA~~ TETRA. | N |