Chemistry 112
Worksheet: Chemical Bonding Review

1. Write electron configurations for each of the following atoms:
   (a) Ca $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
   (b) I $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^5$
   (c) Ar $1s^2 2s^2 2p^6 3s^2 3p^6$
   (d) Zn $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$

2. Write electron configurations for each of the following ions:
   (a) S^{2-} $1s^2 2s^2 2p^6 3s^2 3p^6$
   (b) Na^+ $1s^2 2s^2 2p^6$
   (c) Fe^{3+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$
   (d) Br^- $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$

3. Explain, using the VSEPR Theory, why the geometry of CH_4 is tetrahedral.

4. State whether the following compounds contain polar covalent bonds, nonpolar covalent bonds, or ionic bonds.

(a) KF (3.2) ionic bond

(b) SO_2 (1.0) polar covalent bonds

(c) NO_2 (0.5) polar covalent bonds

(d) HBr (0.7) polar covalent bond

(e) CH_4 (0.4) nonpolar/polar covalent bonds

5. Explain, in detail the three intermolecular forces (dispersion forces, dipole interactions and hydrogen bonding). Give an example of each.

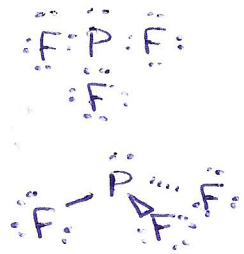
Dispersion forces → Two nonpolar molecules. Electrons from one atom cause the electrons in another atom. Ex. Cl_2 & Cl_2

Dipole Interactions → positive pole from one molecule is electrostatically attracted to negative pole of another molecule. Ex. OF_2 & OF_2

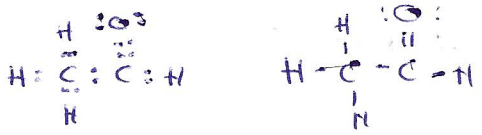
Hydrogen bonding → hydrogen atom bonded to a very electronegative atom is attracted to a lone pair of electrons. Ex. H_2O

6. Draw an electron dot structure and structural diagram for each of the following molecules.

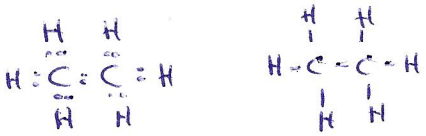
(a) PF_3



(b) CH_3COH



(c) C_2H_6



(d) H_2O

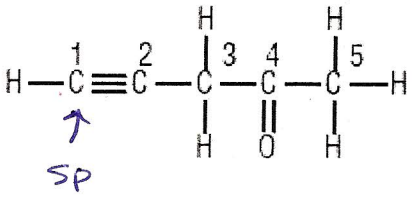
7. Explain the difference between a pi bond and a sigma bond. Which type of bond tends to be weaker?

Sigma bond → head-on overlap of orbitals

Pi bonds → side on overlap of orbitals (weaker)

8. Explain what is meant by orbital hybridization, giving specific reference to the hybridized orbitals in CH_4.

9. Indicate the hybrid orbital used by each carbon atom in the following molecule:



$C_1 \rightarrow sp$

$C_2 \rightarrow sp$

$C_3 \rightarrow sp^3$

$C_4 \rightarrow sp^2$

$C_5 \rightarrow sp^3$

How many total sigma and pi bonds are in the molecule?

$\sigma \rightarrow 11$

$\pi \rightarrow 3$