

## Additional Bonding Problems

### Average Bond Enthalpies (kJ/mol)

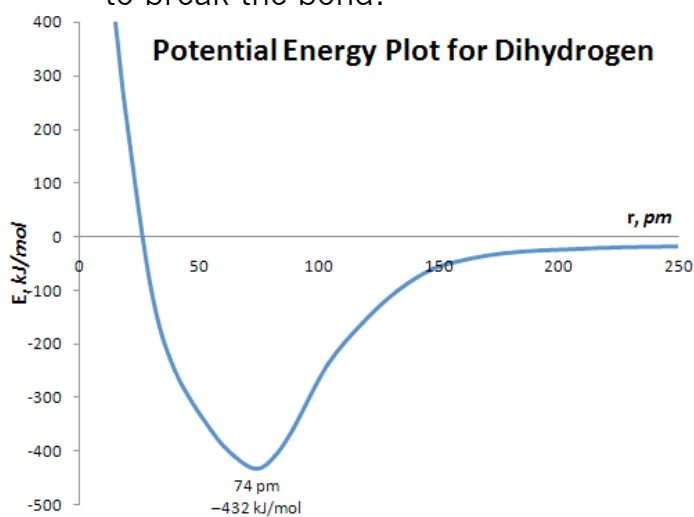
#### Single Bonds

C—H	413	N—H	391	O—H	463	F—F	155
C—C	348	N—N	163	O—O	146		
C—N	293	N—O	201	O—F	190	Cl—F	253
C—O	358	N—F	272	O—Cl	203	Cl—Cl	242
C—F	485	N—Cl	200	O—I	234		
C—Cl	328	N—Br	243			Br—F	237
C—Br	276			S—H	339	Br—Cl	218
C—I	240	H—H	436	S—F	327	Br—Br	193
C—S	259	H—F	567	S—Cl	253		
		H—Cl	431	S—Br	218	I—Cl	208
Si—H	323	H—Br	366	S—S	266	I—Br	175
Si—Si	226	H—I	299			I—I	151
Si—C	301						
Si—O	368						

#### Multiple Bonds

C=C	614	N=N	418	O <sub>2</sub>	495
C≡C	839	N≡N	941		
C=N	615			S=O	523
C≡N	891			S=S	418
C=O	799				
C≡O	1072				

- Using the table of bond energy and your knowledge of molecular structure, find  $\Delta H_{\text{rxn}}$  for
  - $2\text{C}_2\text{H}_2 + 5\text{O}_2 \longrightarrow 4\text{CO}_2 + 2\text{H}_2\text{O}$
  - $\text{C}_2\text{H}_4 + 3\text{Cl}_2 \longrightarrow \text{C}_2\text{Cl}_6 + 2\text{H}_2$
- Consider the plot shown below.
  - What should be the optimal length of an H-H bond?
  - If the atoms are separated by 100 pm, how much energy is required to break the bond?



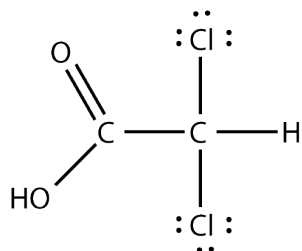
- Show all resonance forms  $\text{NO}_3^{-1}$

## Additional Bonding Problems

4. In terms of formal charges, explain why one structure of carbon dioxide is preferable to the other. (note: I didn't draw in the lone pairs, but you need to in order to determine f.c.)



5. How many sigma and pi bonds are there in the molecule of dichloroacetic acid shown below?

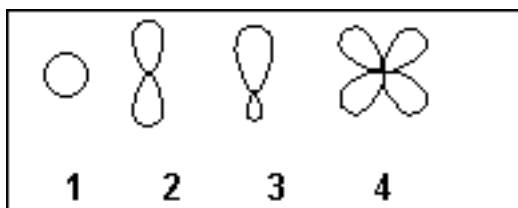


6. Using electronegativity data, determine mathematically whether each of the following bonds is ionic, polar covalent, or non-polar covalent.

Electronegativities of the Elements																
1A												3A 4A 5A 6A 7A				
H 2.1	2A											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Li 1.0	Be 1.5											Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
Na 0.9	Mg 1.2	3B	4B	5B	6B	7B	8B	1B	2B	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8	
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.9	Ni 1.9	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5
Cs 0.7	Ba 0.9	La 1.0	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.9	Bi 1.9	Po 2.0	At 2.2

- C=O
- B-H
- N-H
- K-Cl
- Al-Cl

Questions 7-10 refer to the drawing shown below.



- Which represents a 2p orbital?
- Which represents an s orbital?
- Which represents a d orbital?
- Which represents an  $sp^3$  hybridized orbital?