

CH 222 Winter 2025:

Problem Set #1

Instructions

Step One (all sections):

- **Learn the material** for Problem Set #1 by **reading Chapter 7** of the textbook and/or by watching the videos found on the website (<https://mhchem.org/222>)
- **Try the problems** for Problem Set #1 found on the next pages on your own first. **Write out the answers (and show your work) by hand (on a tablet or paper)**; do not type your answers (and work) to avoid a point penalty. If you write the answers on the problem set itself, you will receive fewer points. Include your name on your problem set!

Step Two:

Section 01 and H1: We will go over Problem Set #1 during recitation. ***Self correct all problems*** of your problem set before turning it in at the end of recitation.

- *Section 01:* due **Monday, January 13 at 1:10 PM**
- *Section H1:* due **Wednesday, January 15 at 1:10 PM**

Section W1: **Watch the recitation video** for Problem Set #1:

<http://mhchem.org/y/c.htm>

- **Self correct all of the problems** while viewing the video. Mark correct problems with a star (or other similar mark), and correct all incorrect problems (show the correct answer and the steps required to achieve it.)
- **Submit Problem Set #1 via email (mike.russell@mhcc.edu) as a single PDF file** (use CamScanner (<https://camscanner.com>), CombinePDF (<https://combinepdf.com>), etc.) by **11:59 PM Wednesday, January 15.**

If you have any questions regarding this assignment, please email (mike.russell@mhcc.edu) the instructor! Good luck on this assignment!

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* Complete problem set on separate pieces of paper showing all work, circling final answers, etc.

* Self correct your work before turning it in to the instructor.

Covering: **Chapter Seven and Chapter Guide One**

Important Tables and/or Constants: "**Bond Enthalpies and Electronegativities**" Handout (after this problem set) and "**Geometry and Polarity Guide**" (Handout, <https://mhchem.org/geopo>)

1. Give the periodic group number, the number of valence electrons and the number of core electrons for each of the following atoms.
 - a. C
 - b. Cl
 - c. Ne
 - d. Si
 - e. Se
 - f. Al
2. Which of the following elements are capable of forming compounds in which the indicated atom has more than four valence electron pairs?

a. C	e. Cl
b. P	f. B
c. O	g. Se
d. F	h. Sn
3. Which compound in each of the following pairs should require the higher temperature to melt?
 - a. NaCl or RbCl
 - b. BaO or MgO
 - c. NaCl or MgS
4. Draw a Lewis structure for each of the following molecules or ions.
 - a. CS₂
 - b. BF₄⁻¹
 - c. NO₂⁻¹
 - d. SOCl₂
5. Draw a Lewis structure for each of the following molecules or ions.
 - a. BrF₅
 - b. IF₃
 - c. IBr₂⁻¹
 - d. BrF₂⁺¹
6. Draw a Lewis structure for each of the following molecules or ions. Describe the electron-pair geometry and the molecular geometry around the central atom.
 - a. ClF₂⁺¹ (note: this is one Cl atom, 2 F atoms, and a +1 charge)
 - b. SnCl₃⁻¹
 - c. BCl₃
 - d. CS₂

Problem Set #1 continues on the next page

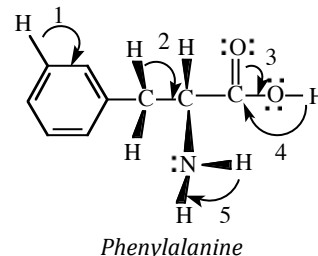
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7. Draw a Lewis structure of each of the following molecules or ions. Describe the electron-pair geometry and the molecular geometry around the central atom.

- SiF_6^{2-}
- PF_5
- SF_4
- XeF_4

8. Give approximate values for the indicated bond angles.

- Cl-S-Cl in SCl_2
- N-N-O in N_2O
- Bond angles 1 - 5 in phenylalanine (right), one of the natural amino acids and a "breakdown" product of aspartame.



9. Determine the formal charge on each atom in the following molecules or ions:

- HCO_2^{-1} (formate ion)
- HCO_2H (formic acid)
- CO_2 (two resonance forms). Which resonance form should be more stable?

10. For each of the bonds listed below, tell which atom is the more negatively charged. Use values of electronegativity to support your answer.

- C-N
- C-H
- C-Br
- S-O

11. Considering both formal charge and electronegativities, predict on which atom or atoms the positive charge resides in the following cations:

- H_3O^+
- NH_4^+
- NO_2^+
- NF_4^+

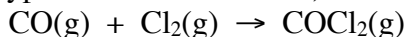
12. Determine if the following molecules are polar or nonpolar. Use a table of electronegativities to determine the most polar bond in the molecules below.

- CS_2
- CF_4
- PCl_3
- CO

13. Give the bond order for each bond in the following molecules or ions:

- CN^{-1}
- CH_3CN
- $\text{CH}_3\text{CH}=\text{CH}_2$
- SO_3^{2-}

14. Phosgene, COCl_2 , is a highly toxic gas that was used as a weapon in World War I. Using bond energies, estimate the enthalpy change for the reaction of carbon monoxide and chlorine to produce phosgene. (*Hint*: First draw the electron dot structures of the reactants and products so you know the types of bonds involved.) The reaction:



Bond Enthalpy Values (kJ/mol)

Bond	Bond Energy	Bond	Bond Energy	Bond	Bond Energy
H-H	436	C-S	260	F-Cl	255
H-C	415	C-Cl	330	F-Br	235
H-N	390	C-Br	275	Si-Si	230
H-O	464	C-I	240	Si-P	215
H-F	569	N-N	160	Si-S	225
H-Si	395	N=N	418	Si-Cl	359
H-P	320	N≡N	946	Si-Br	290
H-S	340	N-O	200	Si-I	215
H-Cl	432	N-F	270	P-P	215
H-Br	370	N-P	210	P-S	230
H-I	295	N-Cl	200	P-Cl	330
C-C	345	N-Br	245	P-Br	270
C=C	611	O-O	140	P-I	215
C≡C	837	O=O	498	S-S	215
C-N	290	O-F	160	S-Cl	250
C=N	615	O-Si	370	S-Br	215
C≡N	891	O-P	350	Cl-Cl	243
C-O	350	O-Cl	205	Cl-Br	220
C=O	741	O-I	200	Cl-I	210
C≡O	1080	F-F	160	Br-Br	190
C-F	439	F-Si	540	Br-I	180
C-Si	360	F-P	489	I-I	150
C-P	265	F-S	285		

Electronegativity Values

← Increasing electronegativity →

		H 2.1																			
		Li 1.0		Be 1.5												B 2.0		C 2.5	N 3.0	O 3.5	F 4.0
		Na 0.9		Mg 1.2												Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0	
Decreasing electronegativity	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-Lu 1.0-1.2		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			
	Fr 0.7	Ra 0.9	Ac 1.1	Th 1.3	Pa 1.4	U 1.4	Np-No 1.4-1.3														