

Chemical Bonding

1.) Which of the following atom pairs would you expect to form **ionic bonds** when they join?

- a) Ba and S
- b) P and Cl
- c) Ca and O
- d) Rb and I
- e) O and H
- f) S and O

2a.) Which compound has the smaller distance between the nuclei of the two ions involved — NaCl or KBr? Explain why.

2b.) What happens to the force of electrostatic attraction between the two ions in an ionic bond as the ions get smaller?

2c.) What happens to the strength of an ionic bond as the ions involved get smaller? What happens to the intermolecular attractive forces as the atoms get smaller, and how does this affect the melting temperature?

3.) Mg^{2+} and Na^+ have roughly the same ionic radius. O^{2-} and F^- have roughly the same ionic radius as well.

Which substance should have a higher melting temperature, **NaF or MgO**? Why?

4.) Which member of the following pairs would you expect to have the **higher melting point**?

- a) CaO or RbI
- b) LiF or NaCl
- c) CsCl or BaS
- d) RbI or KCl
- e) BeO or MgS

5a.) If extra electrons are added to a neutral atom O to make O^{2-} , the resulting ion has the same positive nuclear charge and an increased number of negative electrons surrounding the nucleus. What happens to the amount of electrostatic repulsion existing between the electrons?

5b.) What happens to the volume occupied by the electrons due to the change in the amount of electron-electron repulsion?

5c.) Negative ions are **bigger / smaller** (circle one) than the corresponding neutral atom.

6a.) If electrons are removed from a neutral atom of Mg to make Mg^{2+} , the resulting ion has the same positive nuclear charge and a decreased number of negative electrons surrounding the nucleus. What happens to the amount of electrostatic repulsion existing between the electrons?

6b.) What happens to the volume occupied by the electrons due to the change in repulsion?

6c.) Positive ions are **bigger / smaller** (circle one) than the corresponding neutral atom.

7.) Which of the following atom pairs would you expect to form **covalent bonds** when they join?

- a) S and O
- b) Ba and O
- c) Fe and Cl
- d) N and O
- e) H and S
- f) C and H

8a.) When the distance between two covalently bonded atoms increases, what happens to the electrostatic attraction of their nuclei to the shared electrons in a covalent bond?

8b.) What would you expect to occur to the strength of the covalent bond between two identical halogen atoms when going down the halogen family from F_2 to I_2 ?

9.) What would you expect to occur to the strength of the covalent bond when the number of shared electrons increases?

10.) The distance between the nuclei of two atoms involved in a bond is called the **bond length**. What should happen to the bond length as the number of shared electrons in the bond increases? Why will this happen?

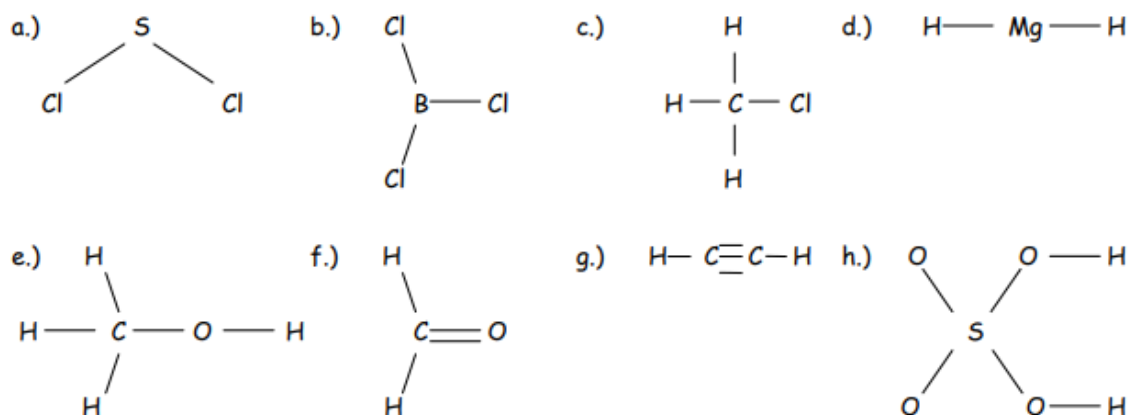
11.) Predict the formula of the compound formed by bonding together the following:

- a) P and Cl
- b) B and O
- c) C and S

- d) P and O
- e) H and Se
- f) F and O
- g) H and O
- h) N and I
- i) B and C
- j) C and Cl
- k) Si and P
- l) Si and S

Polarity

1.) Which of the following molecules will be polar and which will be nonpolar?



2.) Examine the following melting temperatures. All the molecules are polar.

$$\text{NH}_3 = -78^\circ\text{C}$$

$$\text{PH}_3 = -133^\circ\text{C}$$

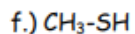
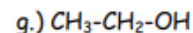
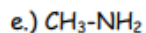
$$\text{AsH}_3 = -116^\circ\text{C}$$

$$\text{SbH}_3 = -88^\circ\text{C}$$

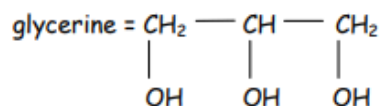
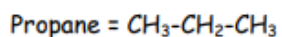
a.) Why do the melting temperatures of SbH_3 , AsH_3 and PH_3 steadily decrease?

b.) Why does the melting temperature of NH_3 suddenly increase going from PH_3 up to NH_3 ?

3.) Which of the following substances would you expect to involve hydrogen bonds?



4.) Suggest a reason why liquid propane has a very low viscosity, whereas liquid glycerine has a very high viscosity.



5.) Classify each of the following with respect to the **most important** type(s) of bonding or forces(s) existing **between** the particles.

a.) 2 molecules of O_2 in O_2 (s)

b.) 2 atoms of Xe in Xe (s)

c.) An atom of C and an atom of Cl in CCl_4

d.) 2 molecules of CH_3F in CH_3F (l)

e.) F and Cs in CsF (s)

f.) atoms of He and Kr

6.) Which should melt at a higher temperature and why?

a.) He or Xe

b.) HBr and Kr

c.) $\text{CH}_3\text{-CH}_3$ or $\text{HO-CH}_2\text{-CH}_2\text{-OH}$

d.) F_2 or Br_2

Lewis Structure

1. Draw the Lewis structure of each of the following ionic compounds.

a. KBr

b. AlCl_3

c. MgO

d. Li_2S

e. K_3P

2. Assign Lewis structures to the following molecules.

HCl $\text{H} \cdots \text{Cl}$		I_2 $\text{I} \cdots \text{I}$	
ICl $\text{I} \cdots \text{Cl}$		C_2H_6 $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	
C_2H_4 $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{O} - \text{C} - \text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$		C_2H_2 $\text{H} - \text{C} - \text{C} - \text{H}$	
BeF_2 $\text{F} \cdots \text{Be} \cdots \text{F}$		O_2 $\text{O} \cdots \text{O}$	
SCl_2 $\text{Cl} \cdots \text{S} \cdots \text{Cl}$		N_2 $\text{N} \cdots \text{N}$	
H_2CO $\begin{array}{c} \text{O} \\ \\ \text{H} - \text{C} - \text{H} \end{array}$		C_4H_4 $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{O} - \text{C} - \text{C} - \text{C} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$	

HCN H—C—N		BH ₃ H H—B—H	
HCSCl S H—C—Cl		NO ₂ ⁻ [O—N—O] ⁻	
NO ⁺ [N—O] ⁺		NCOH H—O—N—C	
NH ₂ ⁻ [H—N—H] ⁻		SO ₂ O—S—O	
S ₂ Cl ₂ Cl—S—S—Cl		N ₂ H ₄ H H N—N H H	
SF ₆ F F F—S—F F F		CNO ⁻ [C—N—O] ⁻	
NO ₃ ⁻ [O—N—O] ⁻ O		C ₄ H ₄ H—C—C—H H—C—C—H	
N ₂ O ₃ O—N—N—O O		CH ₃ CO ₂ H H O H—C—C—O—H H	
SeBr ₄ Br Br—Se—Br Br			