

Chemical Bonding

1.)

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

2a.) NaCl. Both sodium and chlorine have fewer shells, so the ions can bond closer together.

2b.) Increases – Smaller ions mean protons and electrons are closer, increasing attraction.

2c.) Strength increases. Smaller ions = stronger intermolecular forces = higher melting point.

Example: NaCl = 801°C vs. KBr = 734°C

3.) MgO has a higher melting point than NaF due to greater ionic charges. MgO = 2852°C vs. NaF = 993°C

4.)

- a.) CaO
- b.) LiF
- c.) BaS
- d.) KCl
- e.) BeO

5a.) Increases

5b.) Increases

5c.) Bigger

6a.) Decreases

6b.) Decreases

6c.) Smaller

7.)

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

8a.) Decreases – Greater distance = weaker electrostatic attraction

8b.) Decreases – As atomic size increases down the group, bond strength decreases

9.) Increases – More shared electrons = stronger electrostatic attraction = stronger bond

10.) Decreases – More shared electrons = stronger pull = shorter bond length

11.)

- a.) P and Cl – PCl_3
- b.) B and O – B_2O_3
- c.) C and S – CS_2
- d.) P and O – P_2O_3
- e.) H and Se – H_2Se
- f.) F and O – F_2O
- g.) H and O – H_2O
- h.) N and I – NI_3
- i.) B and C – B_4C_3
- j.) C and Cl – CCl_4
- k.) Si and P – Si_3P_4
- l.) Si and S – SiS_2

Polarity

- 1.a) polar
- b) non polar
- c) polar
- d) non polar
- e) polar
- f) non polar
- g) non polar
- h) polar

2 a) Sb, As, and P in this order have decreasing electron numbers the more electrons you have the greater your london forces are. The greater london forces means higher melting point

b) NH_3 has hydrogen bonds as well including london dispersion forces

3. Only c,e,g,h are hydrogen bonds

4. Glycerine has both hydrogen and london forces. High forces = high viscosity

5. a) london forces

b) london forces

c) covalent bond

d) hydrogen bond

e) ionic bond

f) london forces

6. a) Xe larger london forces

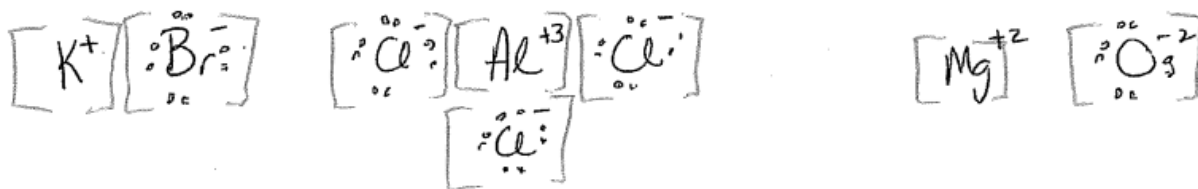
b) Hbr has dipole - dipole forces

c) HO-CH₂-CH₂-OH has hydrogen bonds

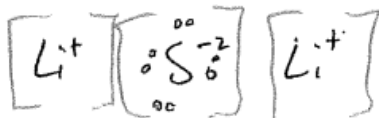
d) Br₂ larger london forces

Lewis Structures

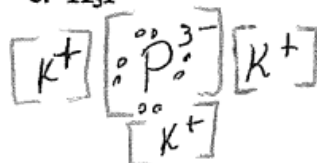
1.



d. Li₂S



e. K₃P



2.

2. Assign Lewis structures to the following molecules.

HCl $1+7=8$ $\text{H}-\text{Cl}$	$\text{H}:\ddot{\text{Cl}}:$ / $\text{H}-\ddot{\text{Cl}}$	I_2 $7+7=14$ $\text{I}-\text{I}$	$\ddot{\text{I}}:\ddot{\text{I}}:$ / $\ddot{\text{I}}-\ddot{\text{I}}$
ICl $7+7=14$ $\text{I}-\text{Cl}$	$\ddot{\text{I}}:\ddot{\text{Cl}}:$ / $\ddot{\text{I}}-\ddot{\text{Cl}}$	C_2H_6 $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ $8+6=14$	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}:\text{C}:\text{C}:\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ / $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$
C_2H_4 $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C}=\text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ $8+4=12$	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C}:\text{C}: \\ \quad \\ \text{H} \quad \text{H} \end{array}$ / $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C}=\text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	C_2H_2 $\text{H}-\text{C}\equiv\text{C}-\text{H}$ $8+2=10$	$\text{H}:\text{C}::\text{C}:\text{H}$ / $\text{H}-\text{C}\equiv\text{C}-\text{H}$
BeF_2 $2+7=16$ $\text{F}-\text{Be}-\text{F}$	$[\text{F}]^+[\text{Be}]^{2-}[\text{F}]^-$	O_2 $6+6=12$ $\text{O}=\text{O}$	$:\ddot{\text{O}}::\ddot{\text{O}}:$ / $:\ddot{\text{O}}=\ddot{\text{O}}:$
SCl_2 $6+14=20$ $\text{Cl}-\text{S}-\text{Cl}$	$:\ddot{\text{Cl}}::\ddot{\text{S}}::\ddot{\text{Cl}}:$ / $:\ddot{\text{Cl}}-\ddot{\text{S}}-\ddot{\text{Cl}}:$	N_2 10 $\text{N}\equiv\text{N}$	$:\text{N}::\text{N}:$ / $:\text{N}\equiv\text{N}:$
H_2CO $2+4+6=12$ $\begin{array}{c} \text{O} \\ \\ \text{H}-\text{C}-\text{H} \end{array}$	$\text{H}:\ddot{\text{C}}:\text{H}$ / $\text{H}-\text{C}-\text{H}$	C_4H_4 $16+4=20$ $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C}=\text{C}=\text{C}=\text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C}::\text{C}::\text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ / $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C}=\text{C}=\text{C}=\text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$

HCN $1+5=10$ H—C≡N	$H:\overset{\cdot\cdot}{C}:\overset{\cdot\cdot}{N}:$ $H-C\equiv N:$	BH ₃ $3+3=6$ H—B—H	$H:\overset{\cdot\cdot}{B}:\overset{\cdot\cdot}{H}$ $H-B-H$
HCSCl $1+4+6+1=12$ H—C—S—Cl	$H:\overset{\cdot\cdot}{C}:\overset{\cdot\cdot}{S}:\overset{\cdot\cdot}{Cl}:$ $H-C-S-Cl$	NO ₂ ⁻ $5+12+1=18$ [O—N—O] ⁻	$:\overset{\cdot\cdot}{O}:\overset{\cdot\cdot}{N}:\overset{\cdot\cdot}{O}:$ $[\overset{\cdot\cdot}{O}-\overset{\cdot\cdot}{N}=\overset{\cdot\cdot}{O}]^-$ or $[\overset{\cdot\cdot}{O}=\overset{\cdot\cdot}{N}-\overset{\cdot\cdot}{O}]^-$
NO ⁺ $5+6-1=10$ [N≡O] ⁺	$:\overset{\cdot\cdot}{N}::\overset{\cdot\cdot}{O}:$ $[\overset{\cdot\cdot}{N}\equiv\overset{\cdot\cdot}{O}]^+$	NCOH $5+6+1=12$ H—O—N—C	$H:\overset{\cdot\cdot}{O}:\overset{\cdot\cdot}{N}:\overset{\cdot\cdot}{C}:$ $H-O=N=C:$ $H-O\equiv N-C:$
NH ₂ ⁻ [H—N—H] ⁻	$[H-\overset{\cdot\cdot}{N}-H]^-$	SO ₂ O—S—O	$\overset{\cdot\cdot}{O}=\overset{\cdot\cdot}{S}-\overset{\cdot\cdot}{O}:$ or $:\overset{\cdot\cdot}{O}-\overset{\cdot\cdot}{S}=\overset{\cdot\cdot}{O}$
S ₂ Cl ₂ Cl—S—S—Cl	$:\overset{\cdot\cdot}{Cl}-\overset{\cdot\cdot}{S}-\overset{\cdot\cdot}{S}-\overset{\cdot\cdot}{Cl}:$	N ₂ H ₄ H—N—N—H H H	$H-\overset{\cdot\cdot}{N}-\overset{\cdot\cdot}{N}-H$ $H-N-N-H$
SF ₆ F—S—F F F	$F-S-F$ F F	CNO ⁻ [C—N—O] ⁻	$[\overset{\cdot\cdot}{C}=\overset{\cdot\cdot}{N}=\overset{\cdot\cdot}{O}]^-$ or $[\overset{\cdot\cdot}{C}-N\equiv\overset{\cdot\cdot}{O}]^-$ $[\overset{\cdot\cdot}{C}\equiv N-\overset{\cdot\cdot}{O}]^-$
NO ₃ ⁻ [O—N—O] ⁻ O	$[\overset{\cdot\cdot}{O}=\overset{\cdot\cdot}{N}-\overset{\cdot\cdot}{O}]^-$ $[\overset{\cdot\cdot}{O}-N=\overset{\cdot\cdot}{O}]^-$ $[\overset{\cdot\cdot}{O}=\overset{\cdot\cdot}{N}-\overset{\cdot\cdot}{O}]^-$	C ₄ H ₄ H—C≡C—C≡C—H H H	$H-C\equiv C-C\equiv C-H$ $H-C\equiv C-C\equiv C-H$
N ₂ O ₃ O—N—N—O O	$\overset{\cdot\cdot}{O}=\overset{\cdot\cdot}{N}-\overset{\cdot\cdot}{N}=\overset{\cdot\cdot}{O}$ or $:\overset{\cdot\cdot}{O}-N=\overset{\cdot\cdot}{O}$ $:\overset{\cdot\cdot}{O}-N=\overset{\cdot\cdot}{O}$ $:\overset{\cdot\cdot}{O}-N=\overset{\cdot\cdot}{O}$	CH ₃ CO ₂ H H—C—C(=O)—O—H H	$H-C(=O)-O-H$ $H-C(=O)-O-H$
SeBr ₄ Br—Se—Br Br Br	$Br-Se-Br$ Br Br		$H-C(=O)-O-H$ $H-C(=O)-O-H$