KEY

Bonding Unit Review Part 1- Putting it All Together

Substance	Lewis structure	Molecular shape	Bond angle	Bond polarity	Molecular polarity	Intermolecular force
NH_3	H-N-H, H	trigonal pyramidal	107.5	3.0 - 2.1 = .9 polar	polar	hydrogen-bond
CO	:C≡O:	linear	—	3.5 - 2.5 = 1.0 polar	polar	dipole-dipole
H_2S	H-S-H	bent	104.5	2.5-2.1=.4 polar	polar	dipole-dipole
CCl_4	Cl-C-Cl, Cl, Cl	tetrahedral	109.5	3.0-2.5=.5 polar	nonpolar	LDF dispersion
Ag	Ag·	—	—	metallic	—	—
SrF_2	Sr^{2+} F^- F^-	—	—	4.0-1.0=3.0 ionic	—	—
exception to 8 SF_6	F, F-S-F, F, F, F	octahedral	90°	4.0-2.5=1.5 polar	nonpolar	LDF
BrCl	Br - Cl	linear	[illegible]	3.5-2.8=0.2 nonpolar	nonpolar	LDF
CO_2	O=C=O	linear	180	3.5-2.5=1.0 polar	nonpolar	LDF
CH_3Cl	H, H-C-Cl, H	tetrahedral	109.5	C-H .4 polar C-Cl 0.5 polar	polar	dipole-dipole
H_2	H-H	linear	—	0 nonpolar	nonpolar	LDF
exception max 4 $BeCl_2$	Cl-Be-Cl	linear	180	2-1.5=.5 polar	nonpolar	LDF
NaCl	Na^+ Cl^-	—	—	2.1 ionic	—	—
Cu	Cu·	—	—	metallic	—	—
CH_2Cl_2	H, Cl-C-H, Cl	tetrahedral	109.5	C-H .4 polar C-Cl .5 polar	polar	dipole-dipole
HCN	H-C≡N:	linear	180	C-H .4 polar C-N 1.0 polar	polar	dipole-dipole
H_2	REPEAT					

BrCl	REPEAT					
CO_2	REPEAT					

Bonding Unit Review- Part 2

1. A covalent bond consists of

B
(a) a shared electron. (c) two different ions.
(b) a shared electron pair. (d) an octet of electrons.

2. If two covalently bonded atoms are identical, the bond is identified as

A
(a) nonpolar covalent. (c) ionic.
(b) polar covalent. (d) dipolar.

3. A covalent bond in which there is an unequal attraction for the shared electrons is

B
(a) nonpolar. (c) ionic.
(b) polar. (d) dipolar.

4. Atoms with a strong attraction for electrons they share with another atom exhibit

C
(a) zero electronegativity. (c) high electronegativity.
(b) low electronegativity. (d) Lewis electronegativity.

5. Bonds that possess between 5% and 50% ionic character are considered to be

C
(a) ionic. (c) polar covalent. — mid range
(b) pure covalent. (d) nonpolar covalent.

6. The greater the electronegativity difference between two atoms bonded together, the greater the bond's percentage of

A
(a) ionic character. (c) metallic character.
(b) nonpolar character. (d) electron sharing.

7. In a crystal of an ionic compound, each cation is surrounded by a number of (+)

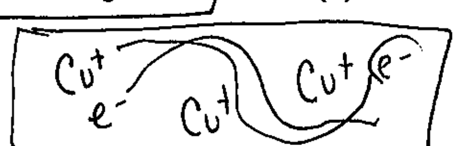
D
(a) molecules. (c) dipoles.
(b) positive ions. (d) negative ions.

8. The forces of attraction between molecules in a molecular compound are generally

B
(a) stronger than the attractive forces among formula units in ionic bonding.
(b) weaker than the attractive forces among formula units in ionic bonding.
(c) approximately equal to the attractive forces among formula units in ionic bonding.
(d) equal to zero.

9. In metals, the valence electrons are considered to be

B
(a) attached to particular positive ions. (c) immobile.
(b) shared by all surrounding atoms. (d) involved in covalent bonds.



electrons can move "mobile"

10. The fact that metals are malleable and ionic crystals are brittle is best explained in terms of their

A (a) chemical bonds. (c) enthalpies of vaporization.
(b) London forces. (d) polarity.

11. Mobile electrons in the metallic bond are responsible for

D (a) luster. (c) electrical conductivity. all properties of metals
(b) thermal conductivity. (d) All of the above.

12. The electrons involved in the formation of a chemical bond are called valence.

13. A chemical bond that results from the electrostatic attraction between positive and negative ions is called a(n) ionic bond.

14. If electrons involved in bonding spend most of the time closer to one atom rather than the other, the bond is polar.

15. Describe how a covalent bond holds two atoms together.
Shared e⁻ travel in both atoms

16. What property of the two atoms in a covalent bond determines whether or not the bond will be polar? (what do you use to determine) electronegativity

17. How can electronegativity be used to distinguish between an ionic bond, polar or nonpolar covalent bond? (What are the ranges for each) 0.0 - 0.3 NP
0.4 - 1.7 P
>1.7 I

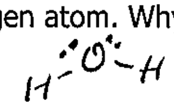
18. What is the difference between intramolecular and intermolecular forces? Which is stronger? → intramolecular
→ within molecule → between molecule

19. If a molecule has resonance, what does that mean?
more than one way to draw Lewis structure

20. Describe the force that holds two ions together in an ionic bond.
electrostatic (+ / -) force

21. How does the behavior of electrons in metals contribute to the metal's ability to conduct electricity and heat? mobile e⁻ help move

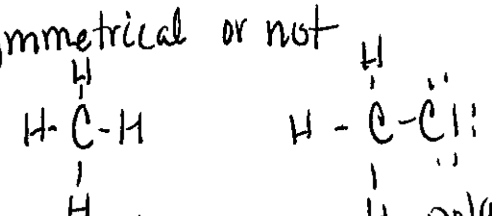
22. Identify the major assumption of the VSEPR theory, which is used to predict the shape of atoms. e⁻ pairs repel eachother; lone pairs repel more

23. In water, two hydrogen atoms are bonded to one oxygen atom. Why isn't water a linear molecule? 2 lone pairs; push bonds down 

24. What factors determine whether or not a molecule is polar?

Symmetrical or not

ex.



nonpolar polar

25. Arrange the following types of attractions in order of increasing strength, with 1 being the weakest and 4 the strongest.

- hydrogen bonding 3
- ionic 4
- dipole-dipole 2
- London dispersion 1

26. How are dipole-dipole attractions, London dispersion forces, and hydrogen bonding similar?

all in covalent molecules ;

27. H_2S and H_2O have similar structures and their central atoms belong to the same group. Yet H_2S is a gas at room temperature and H_2O is a liquid. Use bonding principles to explain why this is. Also why is H_2O polar and CO_2 nonpolar?

H_2O has hydrogen bonding and H_2S has dipole-dipole

H_2O has lone pairs + not symmetrical and CO_2 linear + symmetrical

28. Use the electronegativity values on page 161 of the text, to determine whether each of the following bonds is nonpolar covalent, polar covalent, or ionic.

I a. H—F 4.0-2.1 1.9   d. H—H 2.1-2.1 = 0 NP

I b. Na—Cl 0.9 3.0 3.1   e. H—C 2.1 2.5 .4 P

P c. H—O 2.1 3.5 1.4   f. H—N 2.1 3.0 .9 P

* you need to know range for np, p + ionic bond *

29. Draw the Lewis structure for each of the following, include resonance if applicable.

a. NH_4^+ $[H-\ddot{N}-H]^+$ with H below N

remember if ion (charged atom) put [ ] charge around Lewis structure

b. SO_4^{2-} $[:\ddot{O}-S-\ddot{O}:]^{2-}$ with :Ö: above and below S

c NO_2^- $[\ddot{O}=N-\ddot{O}: \leftrightarrow :\ddot{O}-N=\ddot{O}]^-$

One more time.....

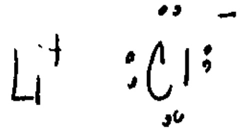
30. For each substance: a) determine the bond polarity; b) draw the Lewis structure for each; c) determine the shape of the molecule; d) determine the molecule polarity; and e) the intermolecular force

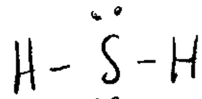
a. CH_4

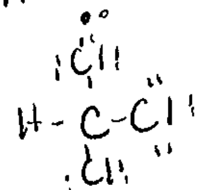
C-H 2.5-2.1 .4 Polar   H-C-H (H above and below C)   tetrahedral   nonpolar   LDF

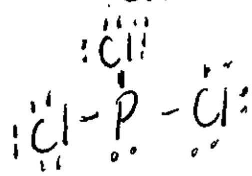
b. C_2H_2

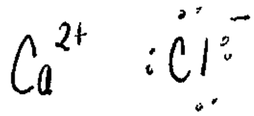
C-H 2.5 2.1 .4 polar $H-C\equiv C-H$ linear   nonpolar   LDF

1.0 3.5 c. LiCl  ——
2.5 ionic

H-S d. H_2S  bent polar dipole-dipole
2.1 2.5
.4 polar

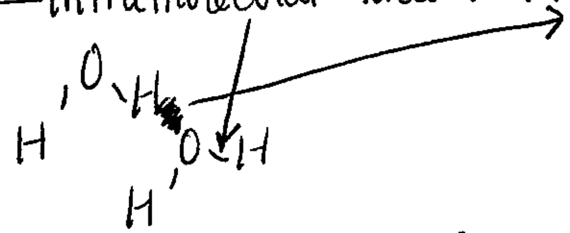
H-C e. $H\underline{C}Cl_3$  tetrahedral polar dipole-dipole
2.1 2.5 .4 polar
C-Cl
2.5 3.5 1.5 polar f. $O\underline{C}Cl_2$

P-Cl g. PCl_3  trigonal pyramidal polar dipole-dipole
2.2 3.0
.8 polar

Ca-Cl h. $CaCl_2$  ——
1.3 3.0 I
1.7

Other things to review:

- bonding helps molecules to become more stable
- lowers potential energy
- intramolecular forces vs intermolecular forces



- Properties of ionic + covalent compounds
  - ionic: high melting pts, soluble in H_2O, conducts electricity as a dissolved solid
  - covalent: lower melting points, doesn't conduct
- stronger intermolecular forces = higher melting points, etc
  H-bonding give H_2O it unique properties
- in phase changes intermolecular forces are broken not intramolecular