Bonding Questions For Review

1. The forces that keep molecules together are called what?
   The forces that keep molecules together are called intermolecular forces (IMF).

2. The forces that keep atoms within a molecule together are called what?
   The forces that keep atoms within a molecule together are called intramolecular forces.

3. Ionic bonds
   a. Describe Ionic Bonds:
   Ionic bonds are a transfer of electrons between a metal ion (the metal loses its electrons and becomes a positive ion – cation), and a non-metal ion (the nonmetal gains electrons and becomes a negative ion – anion). Electrons are held tightly by the anion.
   b. List properties of ionic compounds:
      Ionic compounds don't conduct electricity, unless dissolved in water, or melted, where their dissociated ions can support the flow of electrons.
      Because the bond is so strong, ionic compounds are hard, brittle, solids that have high melting points and boiling points.
      They tend to be soluble in water, because water is polar, and the cations in the ionic compound are attracted to the oxygen end of water, and the anions in the ionic compound are attracted to the hydrogen end of water.

4. Covalent bonds
   a. Describe covalent bonds:
      Covalent bonds are a sharing of electrons between two or more nonmetal atoms.
   b. List the types of covalent bonds:
      Non polar covalent (about 0.0 to 0.4 electronegativity difference)
      Polar covalent (about 0.4 to 1.8 electronegativety difference)
      The bond polarity is a continuum measure, i.e. the greater the difference, the more polar the bond. We treat this measure as a relative measure (used to compare bond polarity, not decide whether a bond is "polar" or not.

5. London Dispersion Forces
   a. Describe London Dispersion Forces (LDF).
      LDFs are weak intermolecular interactions that are caused by the random motion of electrons around atoms. There is a tendency for a brief instant that a high density of electrons if found on one side of a molecule (a negative dipole), and therefore another area of the molecule has a deficiency of electrons (a positive dipole). These dipoles are called instantaneous dipoles, and disappear very quickly due to electron repulsion at the area of high electron density.

   b. What substances exhibit London Dispersion force?
      Non polar substances have LDFs as their most significant IMF.

   c. Explain why larger molecules have greater LDFs than smaller molecules?
      LDFs are increased as we increase the number of electrons in a molecule. Therefore, the greater the molecular mass, the more dispersion forces a molecule has.

6. Dipole-Dipole Forces
    a. Describe Intermolecular dipole-dipole forces.
    Dipole dipole interactions occur between the oppositely charged regions (permanent dipoles) of polar molecules.

    b. What substances exhibit Dipole Forces?
    Dipole dipole interactions occur between polar molecules.

7. Hydrogen Bonding
    a. Describe Hydrogen Bonding.
    Hydrogen bonding occurs between molecules that have F-H, O-H, or N-H bonds. These very polar bonds expose the hydrogen atom's nuclei (making it a positive region). This exposed nucleus is attracted to the lone pair of electrons of a nearby highly electronegative atom (like F, O, or N).

    b. What elements must hydrogen be bonded to in order for hydrogen bonds to occur?
    A F-H, O-H, or N-H (very electronegative, period 2 elements) bond must be present for hydrogen bonding to occur.

8. If substance A has a higher melting and boiling point than substance B, what can you say about the substances' intermolecular forces?
    Substance A requires more energy to break the IMFs than substance B. Therefore substance has stronger overall IMFs than substance B.

9. Nitrogen has 7 protons and 7 electrons, sulfur has 16 protons and 16 electrons. Which of the two have a greater London dispersion forces?
    Sulphur has more LDFs because it has more electrons.

10. Describe metallic bonding.
    Metallic bonding occurs between metal atoms and their free flowing valence electrons. Metals stay together because of the attraction between the metal ions' nuclei and the free flowing valence electrons.

11. What causes an electrical current in alloys (metallic bonds)?
    Metals allow for the flow of electricity because the valence electrons are not held tightly as in ionic or covalent bonds. Valence electrons in metals are free flowing (delocalized). And so when electrons are added to a metal, through repulsion, electrons are pushed along the metal ion structure (if in a wire, they push out the other end of the wire).

12. Describe the binding structure of network covalent (giant) structures.
    Network solids are composed entirely of covalent bonds. They are giant structures, like metals and ionic compounds. As a result they have incredibly high m.p, and b.p. (ionic and metallic bonds are stronger, but because of the greater number or density of bonds, they can be very hard).

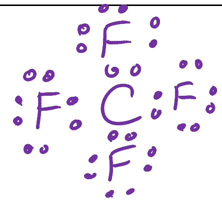
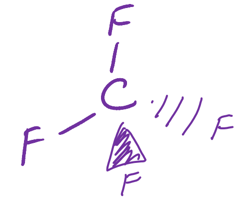
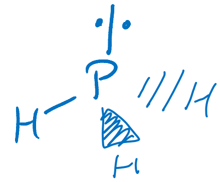
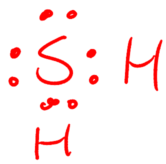
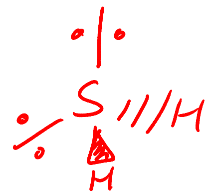
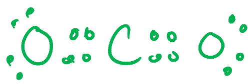
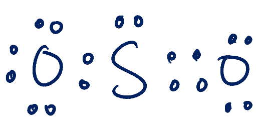
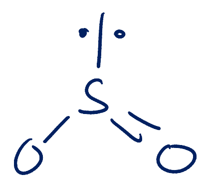
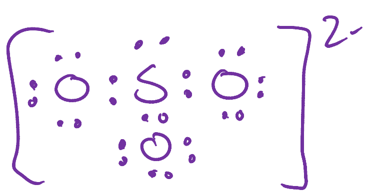
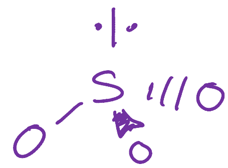
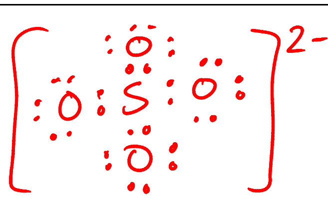
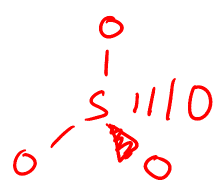
13. What happens to the movement of electrons in a network covalent molecule?
    Electrons are shared, but not delocalized, and so these structures do not conduct electricity.

14. Rank the IMFs from strongest to weakest?
    Hydrogen bonding, dipole dipole interactions, and then LDFs.

15. Complete the following table on atom characteristics.

Atomic Number	Atom Symbol	Group Number	Number of Valence Electrons	Number of Occupied Energy Levels	Lewis Diagram of atom	Number of Lone Electrons Pairs	Number of Bonding Electron
16	S	16(6A)	6	3	S	2	2
14	Si	14 (4A)	4	3	Si	0	4
15	P	15(5A)	5	3	P	1	1
17	Cl	17(7A)	7	3	Cl	3	1
35	Br	17(7A)	7	4	Br	3	1
32	Ge	14 (4A)	4	4	Ge	0	4
1	H	1 (1A)	1	1	H	0	1
6	C	14(4A)	4	2	C	0	4
7	N	15(5A)	5	2	N	1	3
8	O	16(6A)	6	2	O	2	2

16. Complete the following table on atom characteristics.

Molecule or Ion Formula	Total # of e^- /Central Atom	Lewis Structure	Areas of e- density /Lone e- pairs around the central atom	VSEPR Diagram	Name of VSEPR Shape/ Bond Angle
CF_4	$32e^-$ C		4 ∅		Tetrahedral 109.5°
PH_3	$8e^-$ P		4 1		Trigonal Pyramid 107°
H_2S	$8e^-$ S		4 2		Bent 104.5°
CO_2	$16e^-$ C		2 0		linear 180°
HF	$8e^-$ None		— —		linear N/A
SO_2	$18e^-$ S		3 1		Bent 117°
SO_3^{2-}	$26e^-$ S		4 1		Trigonal Pyramid 107°
SO_4^{2-}	S		4 0		Tetrahedral 109.5°