CHEM 115 QUIZ #5 PRACTICE

Provide complete correct answers following the directions provided.

1. Identify which of the attractive forces in each of the following pairs would normally be expected to be the strongest: explain your answers clearly and concisely. (3 points each)

(a) coulombic forces in a "typical" salt vs. covalent forces in a "normal" molecule

coulombic forces are typically stronger than the forces that hold atoms together in molecules – molecules normally decompose at temperatures lower than the temperatures at which vaporization of ionic compounds normally occurs.

(b) metallic bonding in a "typical" METAL (correction) vs. covalent forces in a "normal" molecule

metals have widely variable cohesive forces, however, most do not develop substantial vapor pressures until temperatures are quite high – high enough to decompose many molecules.

(c) coulombic forces in a "typical" salt vs. intermolecular forces between "normal" molecules

typical coulombic forces are decidedly stronger than the typical forces that hold molecules together in the solid or liquid phases – molecules normally vaporize at temperatures much lower than the temperatures at which vaporization of ionic compounds normally occurs.

(d) metallic bonding in a representative metal vs. network covalent

metals have widely variable cohesive forces, however, few are held together as strongly as most network covalent substances (like diamond, sand, etc.)

(e) coulombic forces in a "low-melting" salt vs. metallic bonding in a group 6 transition metal

metals have widely variable cohesive forces, however, group six transition metals have some of the higher melting points and thus quite high boiling points . . . when compared to "low-melting" ionic compounds the metals are held together by stronger attractive forces.

2. For each of the following pairs, indicate which will having the higher forces holding the ions or atoms together and explain your choices. (2 points each, 8 points total)

a. **NaCl** or ~~C_4H_{10}~~

ionic coulombic attractive forces in the salt are stronger than covalent bonds

b. ~~F_2~~ or **HF**

the partial ionic covalent bond in HF are stronger than the purely covalent bond in H_2

c. ~~KBr~~ or **MgO**

ionic coulombic attractive forces in the salts depend on ionic size and charge – in MgO we have ions that are small with charges of +2, -2 . . . in KBr the ions are larger and only carry charges of +1, -1. Higher charge / smaller size leads to stronger forces.

d. SiO_2 or PH_3

the network covalent forces in SiO_2 are stronger than covalent bonds in PH_3

(10 points)

3. The formation of NaCl from the elements is a violent EXOthermic reaction. This process may be viewed as the sum of the following steps (a "Born-Haber cycle"): sublimation, bond dissociation, first ionization process, first electron affinity, and lattice formation. Create two lists, one for the endothermic processes the other for the exothermic processes. Select one process from each list and describe (perhaps showing the process in reaction format?) what happens.

ENDO	*sublimation of sodium*	$Na_{(s)} \rightarrow Na_{(g)}$
	1st ionization of sodium	$Na_{(g)} \rightarrow Na^+_{(g)} + e^-$
	dissociation of Cl_2 bond	$\frac{1}{2} Cl_{2\,(g)} \rightarrow Cl_{(g)}$
EXO	*electron affinity of Cl*	$Cl_{(g)} + e^- \rightarrow Cl^-_{(g)}$
	lattice energy	$Na^+_{(g)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$

(17 points)

4. Provide clear explanations for the following:

(a) metals conduct electricity both as solids and as molten liquids. (4 points)

The sea of electron model does not associate electrons in specific directional bonds. Since the electrons are free to move around through the sea of positive nuclei whether they are in the solid state (locked into specific crystal positions) or in the liquid state (where the nuclei are moving around).

(b) ionic compounds do not conduct as solids but do conduct as molten liquids AND as aqueous solutions (5 points)

In an ionic compound it is the ions that carry charges. When the ionic compound is solid the ions are locked into specific lattice sites and cannot move around. When this is true the compound acts as an insulator. However, when the ionic compound melts the ions are free to move and thus carry electrical charge leading to high electrical conductivity.

(c) molecular solids and their melts normally are not good electrical conductors. (4 pts.)

The bonding electrons associated in specific bonds in a molecular solid are localized and not free to move around, even when the neutral molecules are free to move around (as in the liquid state).

(d) some molecular compounds are strong electrolytes while others are nonelectrolytes. (4 pts.)

The bonding electrons associated in specific bonds in a molecular compound are sometimes shared equally, but are at other times quite ionic in nature. The compounds that have quite large ionic bonding components will frequently dissociate into ions when placed in water (which acts to stabilize the ions created).