

Name Mr. Shank

Period AP 1, 2, 3

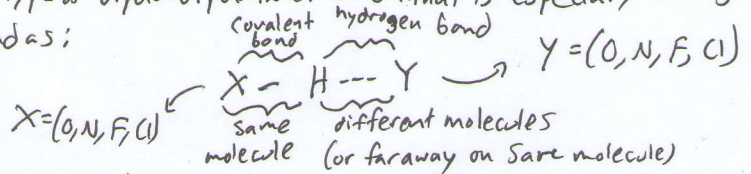
Intermolecular Forces

1. Define dipole-dipole interactions.

Polar molecules have a molecular dipole, which means a separation of negative and positive charge. The partially negatively charged parts of one molecule are attracted to the partially positively charged parts of another molecule. This attraction between permanent molecular dipoles is dipole-dipole interactions.

2. Define hydrogen bonding.

A hydrogen bond is a special type of dipole-dipole interaction that is especially strong. We can depict a general hydrogen bond as:



3. Define London dispersion forces.

Electrons in all molecules constantly and randomly move around the molecule. By chance, there can arise an instantaneous, temporary dipole in which more electrons are on one side of the molecule than another. London dispersion forces are the attraction between two instantaneous (or induced) dipoles.

4. Compounds with hydrogen bonds must have (circle one, both, or neither):

Dipole-Dipole Interactions

London Dispersion Forces

5. Compounds with dipole-dipole interactions must have (circle one, both, or neither):

Hydrogen Bonding

London Dispersion Forces

6. Compounds with London Dispersion forces must have (circle one, both, or neither):

Dipole-Dipole Interactions

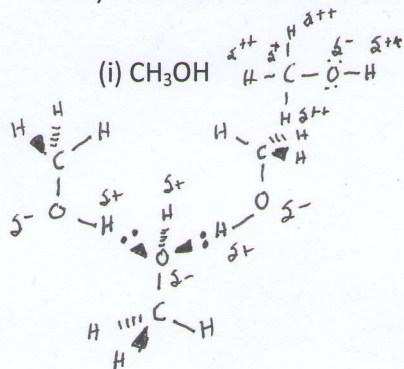
Hydrogen Bonding

7. For each compound below

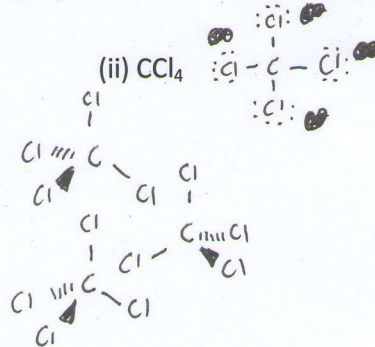
a) Draw the correct Lewis structure and indicate any partial charges.

b) Show the most likely organization of the molecules in a liquid (draw at least 3 molecules)

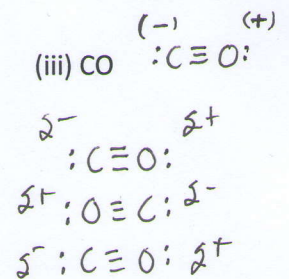
c) Circle the intermolecular forces present in a sample of the compound



(LDF) (DD) (HB)



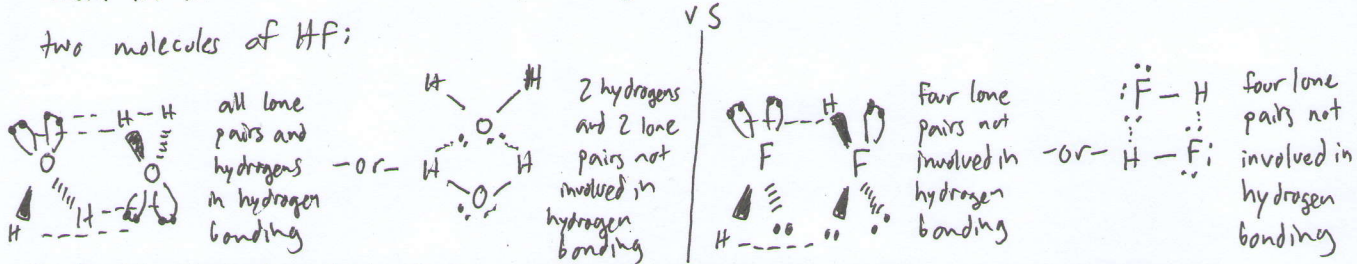
(LDF) DD HB



(LDF) (DD) HB

8. Explain why H_2O has a higher boiling point (373 K) than HF (293 K). Your explanation should include a discussion of intermolecular forces and any appropriate pictures.

In H_2O , a greater percentage of lone pairs and hydrogen atoms are involved in hydrogen bonding than in HF . We can see this by looking at the interactions between two molecules of water and two molecules of HF :



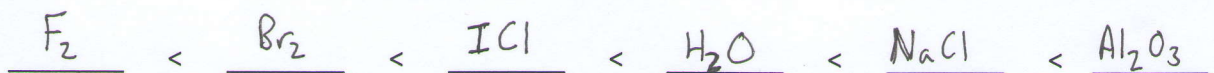
9. Explain why Xe has a higher boiling point (165 K) than Ne (27 K). Your explanation should include a discussion of intermolecular forces and any appropriate pictures.

Xe and Ne , as single atoms, do not possess a permanent molecular dipole. However, they both experience London dispersion forces due to the formation of instantaneous and induced dipoles. The electron configuration of Xe is $[\text{Kr}]5s^2 4d^{10} 5p^6$, and the electron configuration of Ne is $[\text{He}]2s^2 2p^6$. Since the valence electrons on Xe are both much farther from the nucleus and greater in number as compared to Ne , Xe more easily forms larger instantaneous dipoles (we say that Xe is more polarizable). Thus, Xe , by more easily forming instantaneous dipoles and inducing dipoles in other Xe atoms, experiences greater London dispersion forces than the smaller Ne atoms.

10. Explain why Al_2O_3 has a higher melting point (2072 C) than NaCl (801 C). Your explanation should include a discussion of intermolecular forces and any appropriate pictures.

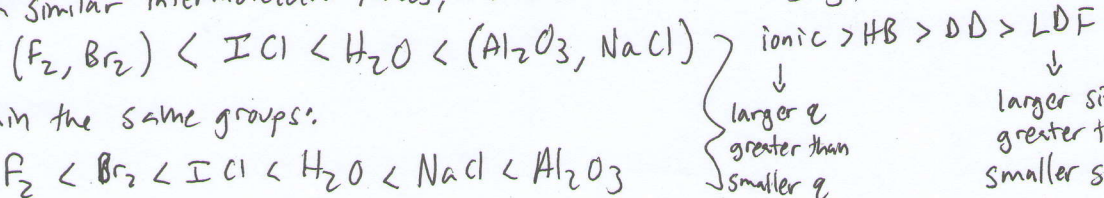
Al_2O_3 and NaCl are both ionic compounds. To melt either one, you must separate oppositely charged ions. It takes more energy to separate ions with larger charges. In Al_2O_3 , the Al ions have a charge of +3, and the O ions have a charge of -2. The product of their charges is -6. In NaCl , the Na ions have a charge of +1, and the Cl ions have a charge of -1. The product of their charges is -1. Since Al_2O_3 has ions with greater charge than NaCl (and, thus, a greater product of charges), it is more difficult to separate ions in Al_2O_3 , and its melting point is higher.

11. List the following compounds in order of increasing boiling point: Al_2O_3 , F_2 , H_2O , Br_2 , ICl , NaCl



* To solve this kind of problem, first list the intermolecular forces present in a sample of each compound:
 ~~Al_2O_3 (ionic); F_2 (LDF); H_2O (LDF, HB, DD); Br_2 (LDF); ICl (LDF, DD); NaCl (ionic)~~

* Next, group compounds with similar intermolecular forces, and rank them accordingly:



* Last, rank compounds within the same groups:

