BOND POLARITY & MOLECULAR POLARITY

EXPLORATION:

1) Rewrite the definition of electronegativity.

2) Look at Figure 12.4 on p. 363. Describe the differences between a nonpolar covalent bond, a polar covalent bond, and ionic bond in terms of charges and the way the electron cloud is distributed.

3) Define polar and nonpolar based on your answer to #2.

4) If a molecule has only nonpolar bonds, can it be polar? Why or why not?

CONCEPT FORMATION:

5) Explain how electronegativity differences determine the type of bond formed .

APPLICATION:

6) Do Self-Check Exercise 12.1 on p. 363.

7) Do Problem 16 on p. 395.

IONIC BONDING

EXPLORATION:

1) Look at Figure 12.4 on p. 363. What happens when atoms with very, very large electronegativity difference (such as Li and F) react with each other? What forms?

2) Look at Figure 12.9 on p. 370. Compare the sizes of cations and anions.

3) Give the reason for the relative sizes of cations and anions.

4) Read p. 369. How stable are ionic compounds?
5) How are the ions in an ionic compound arranged?

6) What force (this requires you to think back to middle school science) holds an ionic compound together?

Ms. Kim will give you the formula for this force. Write it in the box and define variables:

7) What is the sign of F when q_1 is + and q_2 is -? _____ What is the sign for an attractive force?_____
8) What is the sign of F when q_1 is + and q_2 +? _____ What is the sign for a repulsive force? _____

CONCEPT FORMATION:

9) If q_1 were to increase from +1 to +2, and q_2 was -1, what happens to the magnitude of F?

10) Assuming all other variables stay the same, what happens to the magnitude of F as d increases from 132 picometers to 247 picometers?

11) How is ion charge related to the magnitude of F?
12) How is ion size related to the magnitude of F?

APPLICATION:

13) How is the F calculated related to ionic bond strength?

14) What ionic compound has a stronger ionic bond, LiF or CaF_2? (Assume the size changes are not very large) Why?

15) What ionic compound has a stronger ionic bond, LiF or KBr? Why?

16) How are stability, attractive force, and the energy required to take a solid apart related? If a lot of energy is required, what does this mean? If not a lot of energy is required, what does this mean?

17) Would you expect LiF or CaF_2 to have a higher melting point? Why?

18) Would you expect LiF or KBr to have a higher melting point? Why?

INTERMOLECULAR FORCES

DIPOLE-DIPOLE FORCES:

EXPLORATION:

1) What is the difference between intermolecular forces and intramolecular forces (also called bonds)?

2) What type of molecule has a dipole moment? (What is a dipole again?)

3) Look at Figure 14.3 on p. 442. What happens when you have two molecules with a dipole moment? What is this called?

CONCEPT INVENTION:

4) Recall the formula Ms. Kim gave you. Why are dipole-dipole forces only about 1% as strong as covalent and ionic bonds? THINK!

5) Recall the formula Ms. Kim gave you. Why do dipole-dipole forces become weaker as the distance between the dipoles decreases?

6) Why do dipole-dipole forces become unimportant or negligible in the gas phase?

APPLICATION:

7) Is a dipole-dipole attraction permanent or temporary? Is the attractive interaction stronger or weaker than an ionic bond? Why?

8) Would CO_2 have dipole-dipole forces? Why or why not?

9) Draw two CO molecules. Indicate how they would line up, and draw the intermolecular force as a dashed line.

HYDROGEN BONDING

EXPLORATION:

1) Hydrogen bonding isn't actually bonding. It's a super-strong dipole-dipole attraction. What two factors account for the strength of the dipole-dipole attraction? (Reference the formula Ms. Kim gave you!)

2) What three types of bonds are responsible for the two factors you mentioned in #1? Why these three bonds?

CONCEPT FORMATION:

3) Draw two HF molecules. Indicate how they would line up, and draw the intermolecular force as a dashed line. Is this attractive force stronger or weaker than the attraction between two CO molecules (#9 of previous set)?

4) Rank the strength of the hydrogen bonds between HF, H_2O, and NH_3. Explain why you ranked them this way.

APPLICATION:

5) What happens when you boil a substance? How is this related to intermolecular forces? Would something that has strong intermolecular forces require a lot of energy or a little energy to make it boil?

6) Rank the boiling points of HF, H_2O, and NH_3 from lowest to highest. Explain.

LONDON DISPERSION FORCES

EXPLORATION:

1) How do temporary, weak dipoles form in atoms and molecules that aren't polar?

2) What is an "instantaneous dipole" and "induced dipole," and how are these related to the formation of London dispersion forces?

3) Compare the strength of these dipoles formed to those in polar molecules:

4) Under what conditions do London dispersion forces become more significant?

CONCEPT FORMATION:

5) Rank the strength of dipole-dipole forces, hydrogen bonding, London dispersion, and ion-ion attractions (ionic bonding) from weakest to strongest. Explain (Hint: Look at the formula Ms. Kim gave you.)

APPLICATION:

6) The introductory paragraph on p. 442 states: "Most substances consisting of small molecules are gases at normal temperatures and pressures. Examples are O_2, N_2, CH_4, and CO_2. A notable exception to this rule is water." Also, ionic compounds exist as solids. Using the examples, explain how the physical state observed is related to the intermolecular forces of attraction in each compound.

7) Viscosity—is a property of a substance that makes it resistant to flowing. Pancake syrup, for example, has high viscosity. Explain how viscosity is related to intermolecular forces.

8) Volatility—describes how easily a substance vaporizes.
Vapor pressure—is also a property of a liquid that measures how easily it vaporizes or turns from liquid to gas (it's the pressure of the gas above a liquid at equilibrium). For example, gasoline has a high vapor pressure and is very volatile. Explain how volatility and vapor pressure are related to intermolecular forces.

PROPERTIES OF SOLIDS & THE LAB

EXPLORATION:

1) What are the names and type of solid for the five solids we examined in the lab? What are the components of each solid (Atoms? One giant molecule? Several molecules? Ions?)

2) What type of bonding (ionic, polar covalent, nonpolar covalent, metallic) occurs in each?

3) Read p. 458. Why aren't solids such as diamond, which is a "giant molecule", classify as molecular solids?

METALLIC BONDING

EXPLORATION:

4) What model explains the properties of metals? Draw a diagram.

CONCEPT INVENTION (Associate solid type with property observed—pattern recognition):

5) What kind of intermolecular forces are found in each of the five solids? What are the typical properties observed for network covalent, metallic, ionic, and polar and nonpolar covalent solids?

- melting point
- hexane conductivity
- water solubility
- volatility
- water conductivity
- solid conductivity
- hexane solubility

APPLICATION:

6) Explain your observations in #6 (WHY?) :
- melting point
- water solubility
- water conductivity
- hexane solubility
- hexane conductivity
- volatility
- solid conductivity