Intermolecular Forces Practice

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1. Co-ordinate covalent bond: a bond in which both of the electrons were contributed by one of the atoms
2. Two or more possible Lewis structures of the same molecule in which the structures differ only in the positioning of their bonding and lone pairs. The actual structure of the molecule is most likely a combination, or hybrid, of all possible Lewis structures. They are used when no single Lewis structure properly describes the observed characteristics of the molecule. For example, when measurements of bond lengths are between the lengths of a single and a double bond but a Lewis structure cannot be drawn to represent it. (See examples on page 230 of the student text.)
3. To determine the shape of a molecule, you need to know the total number of electron groupings (bonding pairs and lone pairs) around the central atom. A Lewis structure is needed in order to determine the number of electron groupings.
4. a) bent b) trigonal pyramidal c) trigonal pyramidal d) linear
5. PF_5 has five electron groups, all of which are bonding pairs. IF_5 has six electron groups and one of them is a lone pair.
6. a) BF_3 Boron trifluoride has three electron groupings around the boron atom so it is trigonal planar.

b) AsF_3 Arsenic trifluoride has four electron groupings (three bonding pairs and one lone pair) so the electron pairs have a tetrahedral arrangement, but the shape is trigonal pyramidal.

c) AsF_5 Arsenic pentafluoride has five electron groupings so it is trigonal bipyramidal.

7. a) HCN The shape is linear and the molecule is polar.

b) CH_3F The shape is tetrahedral and the molecule is polar.

c) NOF The shape is bent, and the molecule is polar.

d) CS_2 The molecule is linear and the bonds are not polar, so the molecule is non-polar.

8. I. Check for solubility in water. The polar compound should dissolve but the non-polar compound should not dissolve.

II. Check for the melting point. The polar compound will have a higher melting point than will the non-polar compound.

III. Check for the boiling point. The polar compound will have a higher boiling point than will the non-polar compound.

IV: Put the solutions into a burette and bring a charged rod close to the stream of liquid and the polar molecules will bend.

11. a) *London dispersion forces*: Neon consists of individual atoms that do not form ions, so polarity is not a factor (nonpolar)

b) *hydrogen bonding (a special case of dipole-dipole bonding)*: Each water molecule has two –OH bonds so a single molecule can form hydrogen bonds with several other water molecules

c) *dipole-dipole bonding*: $CHCl_3$ is polar so each molecule is a dipole

d) *London dispersion forces*: BF_3 is trigonal planar in shape so it is completely symmetrical. The bond polarities cancel each other out. Therefore, it is a nonpolar molecule

12. In an ion-dipole force, an ion and the oppositely charged end of a dipole attract each other electrostatically. An ion-induced dipole force acts between an ion and a non-polar molecule. When the ion approaches the non-polar molecule, it draws negative charges within the molecule toward itself and repels the positive charges in the molecule. These forces cause the once non-polar molecule to become a dipole. Once formed, the ion attracts the oppositely charged end of the induced dipole.

13. a) dipole-dipole forces b) ion-dipole forces

14. The observation that nonpolar molecules have such variation in their melting points (we wouldn't see the trend of increasing mp with increasing size)