Chemistry: Intermolecular Forces Notes

How to Determine Molecular Polarity & Molecular Dipole
Bond dipoles and molecular dipoles are *vector* quantities. Vector quantities consist of both a magnitude and direction. An example of a vector quantity would be distance: you walked north 2 kilometers, which is different than if you had walked east 2 kilometers. In these examples, north and east are the direction component of the vector and 2 kilometers is the magnitude component. In our bond dipoles the length of the dipole arrow is the magnitude component, and the way it is pointing is the direction component. The molecular dipole is determined by adding the individual bond dipoles. Adding vectors is complex, because we need to add both their magnitude and their direction. We can add vectors mathematically and graphically. The mathematical method is beyond the scope of this course. We will learn it in physics. We will use the graphical method to add vectors. This is called the tail-to-head method.

Direction	Examples
If the bond dipoles are the same strength, then the direction of the molecular dipole will be an average of the bond dipoles.	
The molecular dipole will point in the same general direction as, or "lean" toward, the stronger bond dipole.	

Strength	Examples
The molecular dipole is an “average” or combination of the individual bond dipoles.	
If the bond dipoles have at least part of their direction in common, then the molecular dipole will be stronger than the individual bond dipoles.	
If the bond dipoles are in opposite directions, then they will either partially or completely cancel out each other.	

Molecular Shapes	
Symmetrical Molecular Shapes Linear Trigonal Planar Tetrahedaral	Asymmetrical Molecular Shapes Bent Trigonal pyramidal
Symmetrical molecules will be non-polar if all the bond dipoles are the same strength and are either all pointing toward or all pointing away from the central atom. This is the case if the exterior atoms are the same.	
Symmetrical molecules with bond dipoles that have different strengths and/or different directions will have molecular polarity. This is the case if the exterior atoms are not all the same.	
Asymmetrical molecules will have molecular polarity even if the bond dipoles are the same strength and pointing in the same direction.	

Intermolecular Forces – What Attracts the Molecules to Each Other?	
Electrostatic forces. The positively charged end of one molecule aligns with the negatively charged end of another molecule.	
London Dispersion Forces Temporary dipoles are created in the electron cloud of the molecule because the moving electrons create regions of partial positive and partial negative charges. These attractions are constantly broken and reformed. All molecular compounds, including non-polar compounds have this IMF.	
Dipole-Dipole Attraction The attraction between the permanent positive and negative poles that are created by the partial positive and partial negative charges. All molecular polar molecules have this IMF.	
Hydrogen Bonding A special type of dipole-dipole attraction between the hydrogen atom from one molecule and the lone pair(s) of electrons of an oxygen, nitrogen or fluorine atom from another molecule. Molecules must have an H atom covalently bonded to either an N, O or F to have this IMF.	
Ionic Bonding The attraction created between the full positive charge of the cation and the full negative charge of the anion. Must be an ionic compound to have this IMF.	
Some compounds have more than one type of IMF. • Non-Polar: London Dispersion (LD) forces. • Polar Molecules: LD and dipole-dipole (DD) attraction • Polar Molecules with H <u>and</u> either N, O or F: LD, DD and hydrogen bonding. • Ionic Compounds: Ionic bonding	