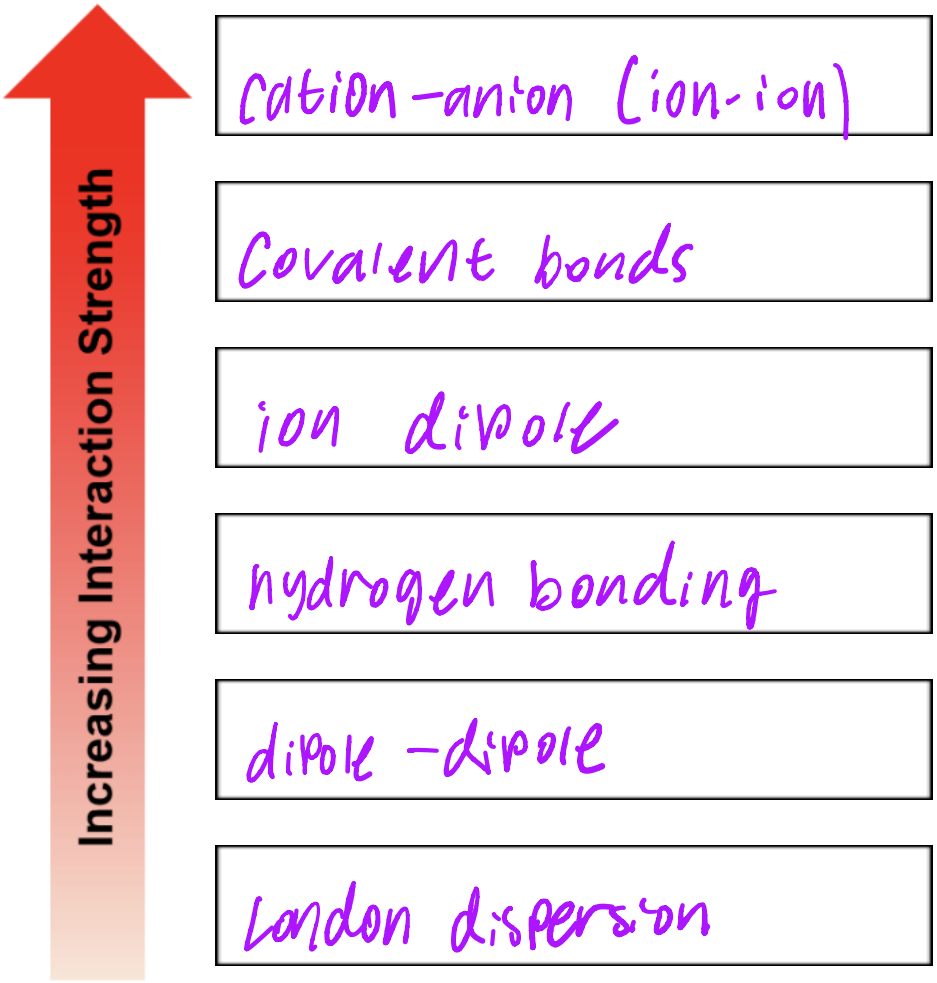
Session 4 Worksheet

Physical Properties and Intermolecular Forces: A Better, Comprehensive Guide



Physical Properties

For this class we are talking about mp and bp

Intermolecular Forces

Ion-Ion:

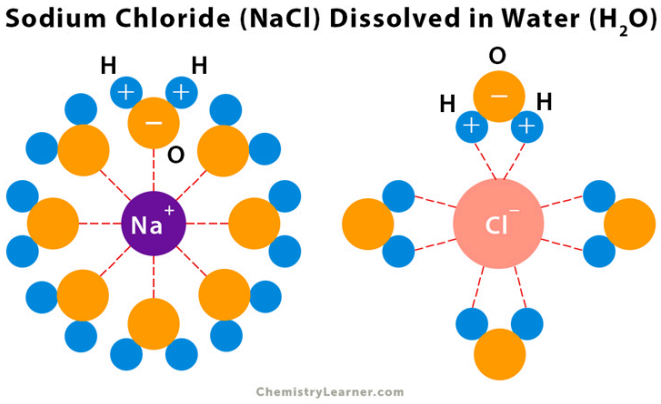
- Typically observed in crystals and salts
- Both mp and bp are very high

Covalent Bonds:

- An intermolecular force within the compound itself
- Considered strong because of the sharing of electrons

Ion-Dipole:

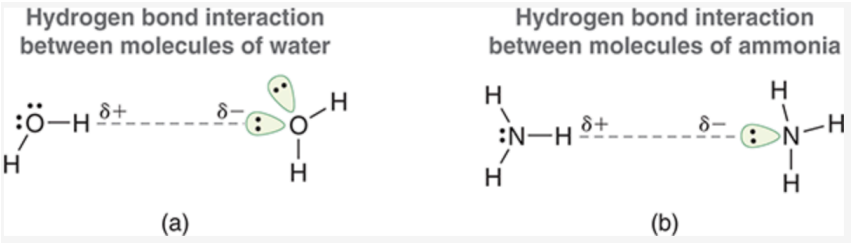
- The interaction of a dipole and the +/- charge of an ion



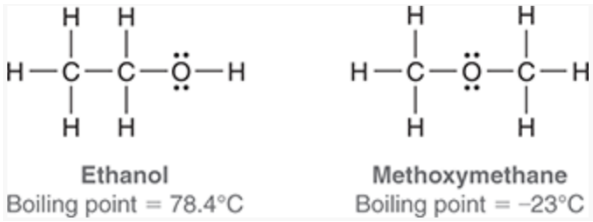
Hydrogen Bonding:

- Not technically a "bond", more like another form of attraction

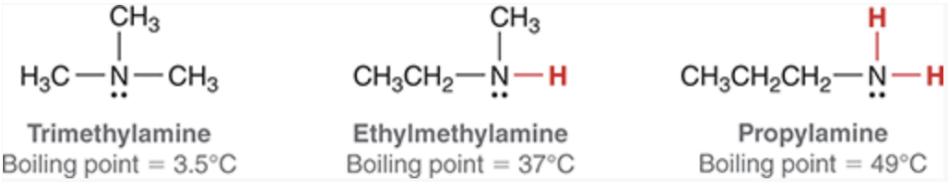
A hydrogen is connected to an EN atom (O, N, F)



How does this affect bp & mp?



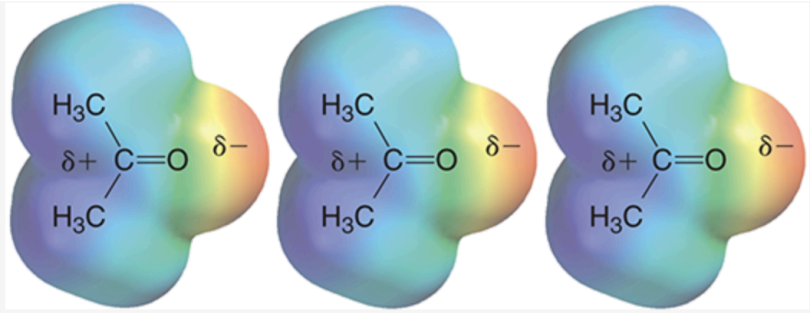
Ethanol has a higher bp because it has a hydrogen bonded to, versus Methoxymethane, which only has a _____C–O_____bond



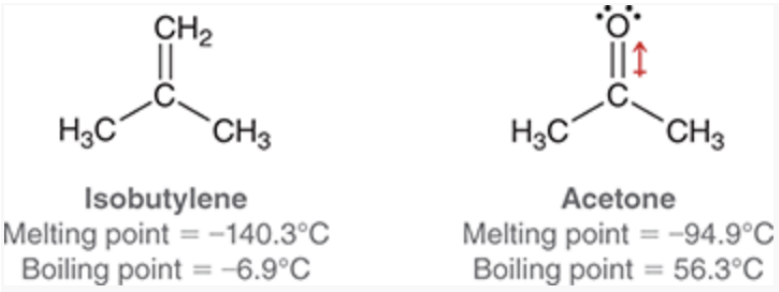
Notice how as more hydrogens are bonded to the Nitrogen atom, the _____higher_____ the bp gets

Dipole-Dipole:

The resulting _____net attraction_____ between two dipoles



How does this affect bp and mp?



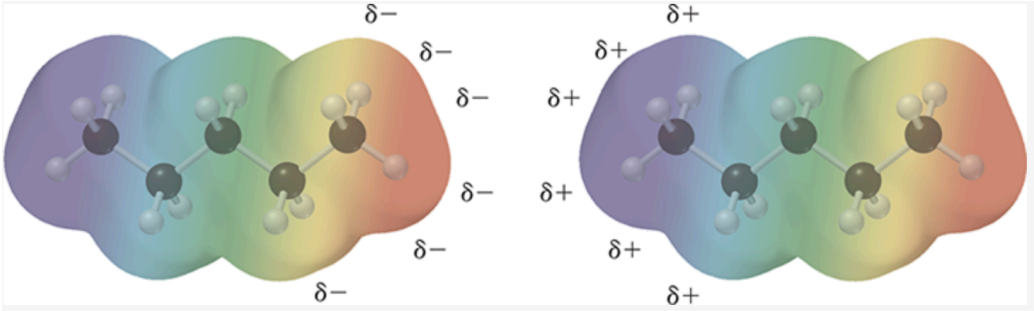
Isobutylene lacks _____a significant dipole_____, so the mp and bp are much lower compared to Acetone, which has _____strong net dipole_____

London Dispersion Forces:

A consideration of the ___positive___ and ___negative___ charges on a whole molecule, rather than the entire atom

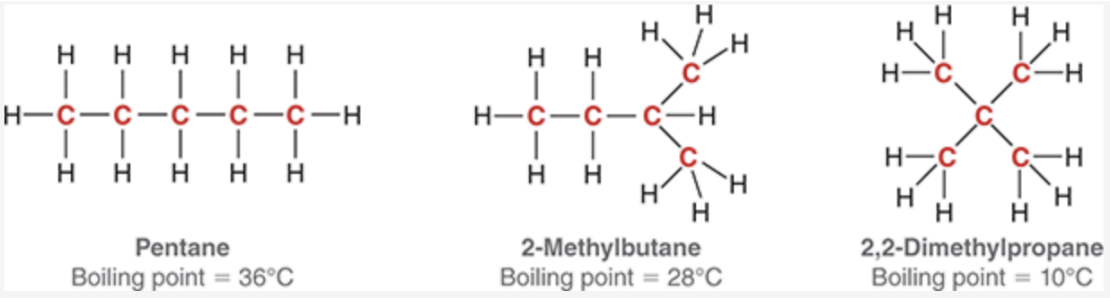
Usually observed in large ___hydrocarbons___

This force is transient, or ___temporary___



How does this affect bp and mp?

The ___longer___ the carbon chain, the ___higher___ ~~higher~~ the bp



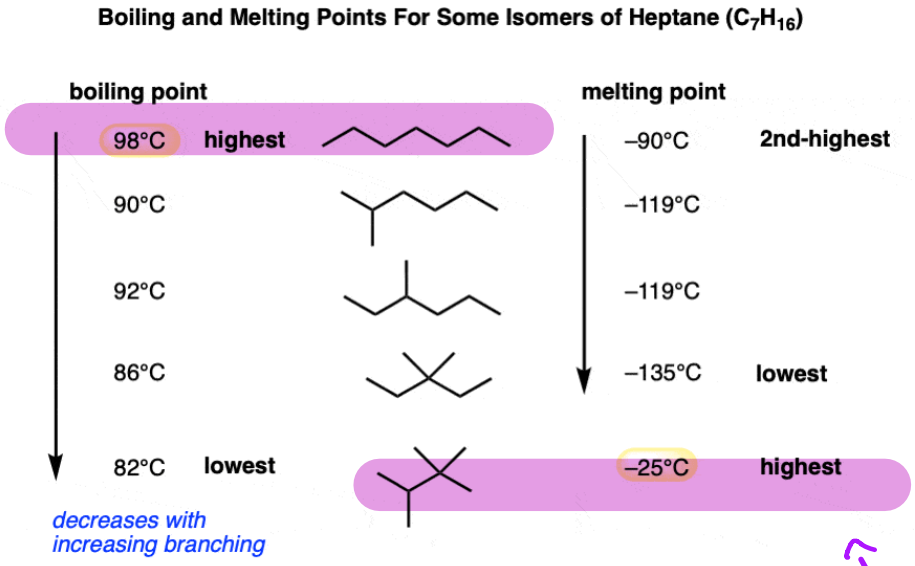
The more ___branching___, the ___lower___ the bp

Melting Point

We've been talking about boiling point up until here; however, melting point properties have different requirements

- When it comes to branching, **generally,** the most branched structure will have a ___high___ melting point (there are exceptions)

- This is largely due to Structure and the ability of the molecules to stack



↑ pay attention to the extremes

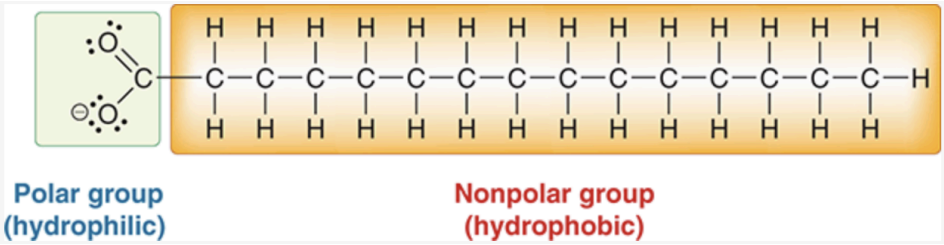
Solubility

"Like dissolves like"

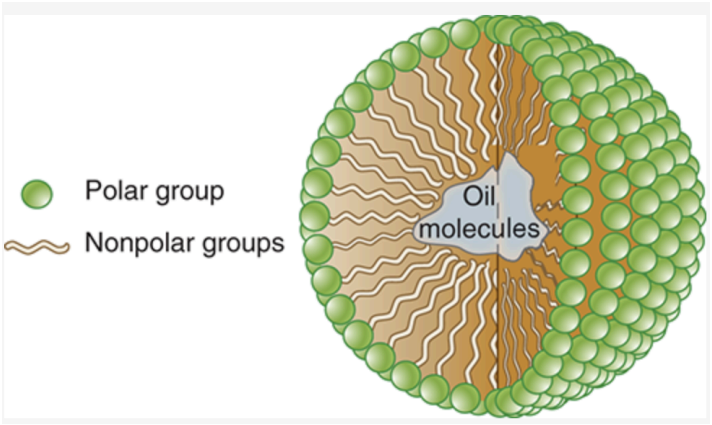
Polar compounds will dissolve polar compounds

Non-polar compounds will dissolve non-polar compounds

Determining Solubility: at least 3g dissolves in 100mL for the compounds to be soluble to each other



Because soap has both a polar and non-polar group, it can form a structure called a micelle to "wash" away an oil molecule, while also being soluble in water



Practice Questions

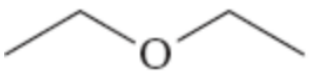
1. Which of the following compounds has the higher boiling point?

A. CH_3OH
B. NaCl
C. Benzene
D. CH_3CH_3Cl

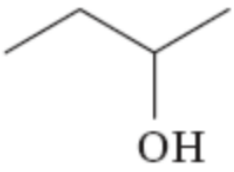
2. What compound will be soluble in Water?

A. Cyclohexane
B. CH_3CH_3OH
C. CCl_4
D. $CH_3CH_3CH_3CH_3CH_3$

3. Rank the compounds in order of decreasing boiling point. lowest → highest bp



I



II

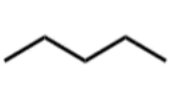
III

A. II < I < III
B. I < II < III
C. III < II < I
D. III < I < II

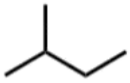
4. What intermolecular force is present in all molecules?

A. Hydrogen Bonding
B. Ion-Dipole
C. London Dispersion
D. Dipole-Dipole

5. What is the boiling point and melting point relationship between the following compounds?



n-pentane



2-methylbutane

2,2-dimethylpropane

A. N-pentane has the highest melting point and boiling point
B. 2,2-dimethylpropane has the highest melting point, and n-pentane has the highest boiling point
C. 2-methylbutane has the highest melting point, and 2,2-dimethylpropane has the highest boiling point
D. 2,2-dimethylpropane has the highest boiling point, and n-pentane has the highest melting point