Paper Chromatography

Intermolecular Forces

Types of forces

Intermolecular forces: attractive forces between molecules

Intramolecular forces: hold atoms together in a molecule

Comparison: Intermolecular vs. intramolecular

Intermolecular: 40 kJ to vaporize 1 mole of water

Intramolecular: 460 kJ to break O-H bonds in 1 mole of water

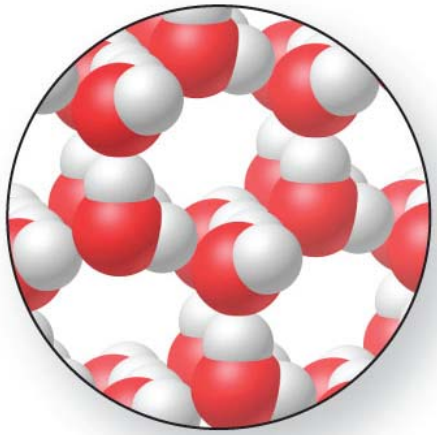
Intermolecular forces weaker than intramolecular forces

Hydrogen Bonds

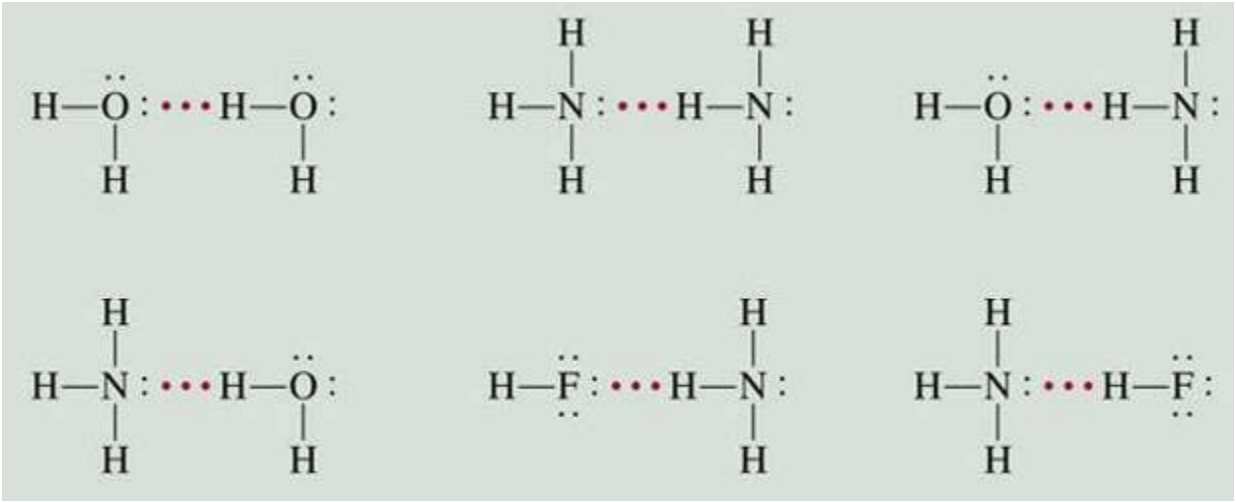
Bond between H atom (+) bonded to a nonmetal atom (-) and attracted another non-metal atom (-)

O,N,F must be bonded to H

- Creates linear group of 3 atoms
- Strength > dipole-dipole



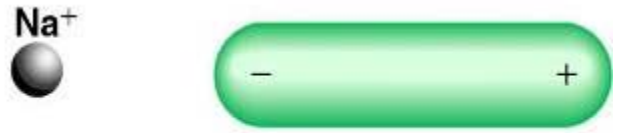
Ice

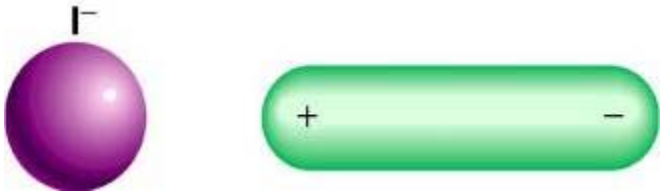


Ion-Dipole Forces

Attractive forces between an ion and a polar molecule

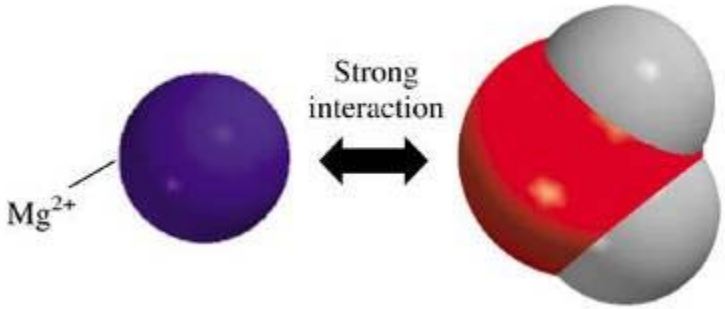
Electrostatic charges only
No induced charges



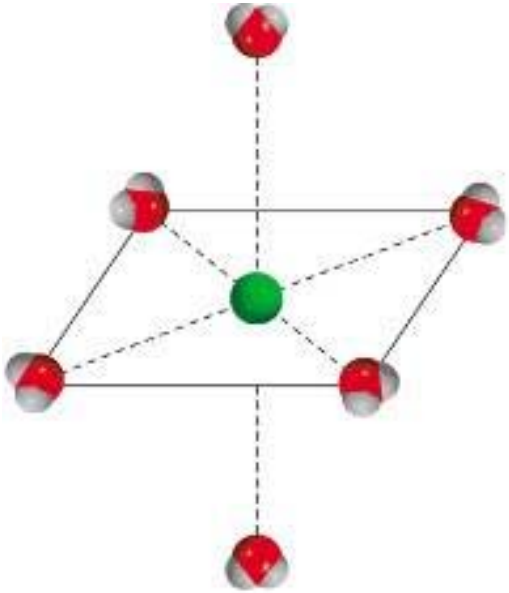


Hydration

Cations/anions interact with water
Dissolve ionic salts
Polar H_2O molecules surrounds ion



Higher charge
Stronger force

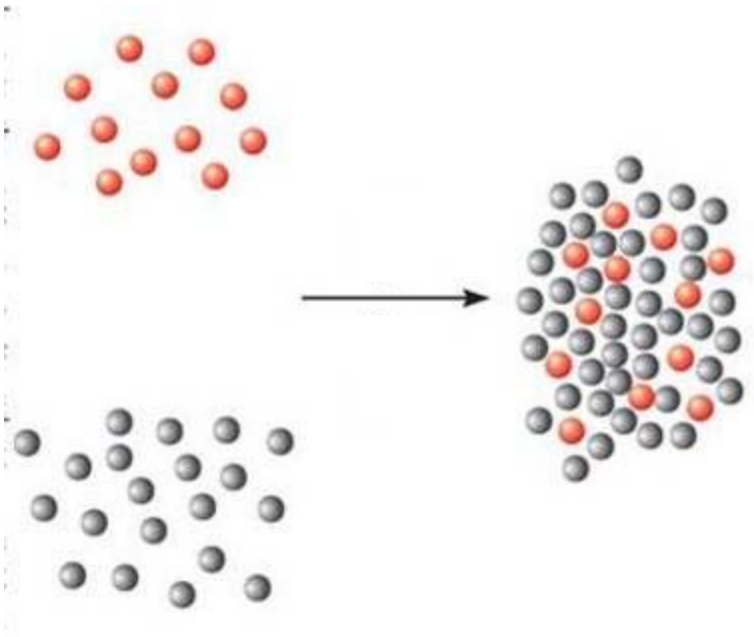


Solvent/Solute Intermolecular Forces and Polarity

The rule of thumb is that "like dissolves like."

Intermolecular forces strongest for similar compounds

- Polar solvent/polar solute
- Nonpolar solvent/nonpolar solute
- Solvent and solute are “miscible”
- Fully dissolve in one another
- Stable as a solution



Examples:

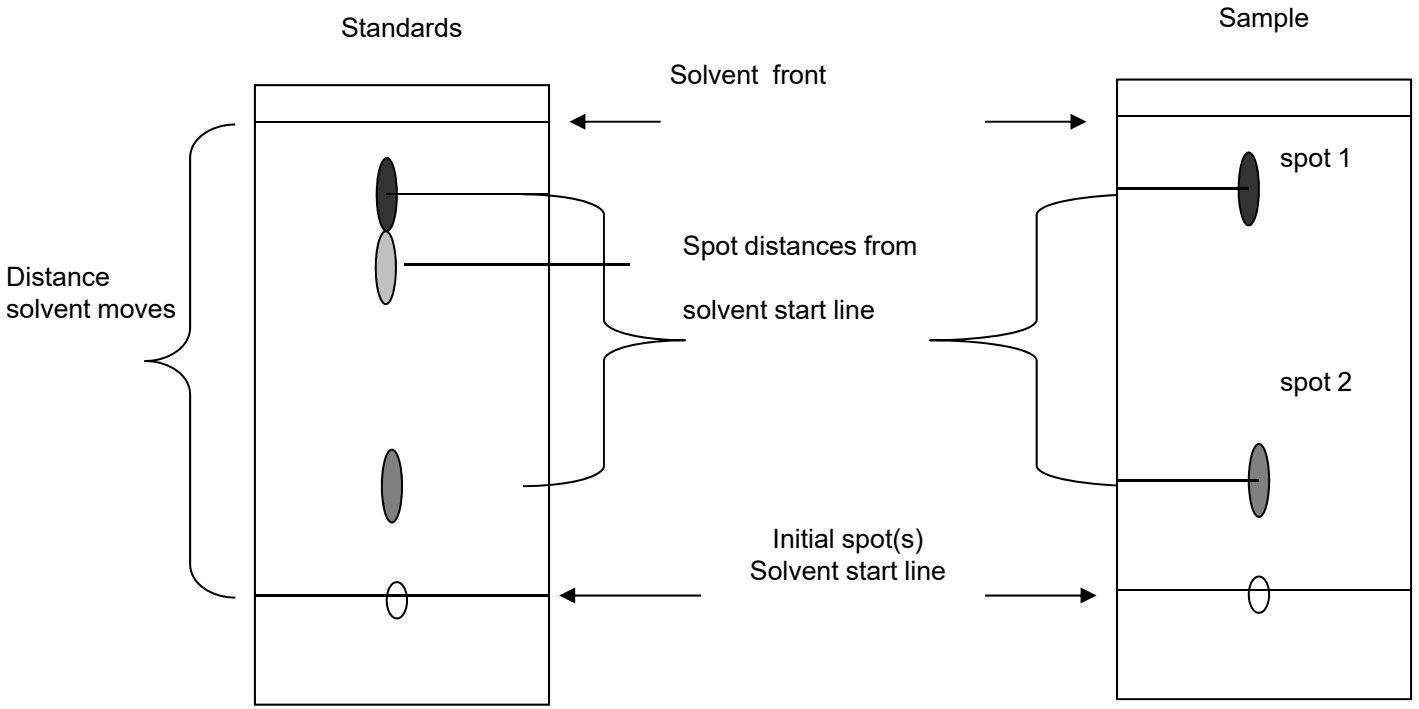
- water/methanol solutions
- Dissolution of ionic salts in H_2O
- CCl_4 in benzene, C_6H_6

Paper Chromatography

Separating dyes based on polarity with 2 solvents

1. Pure water: Just hydrogen bonding: high polarity
2. 5% salt water: Ion dipole bonding, higher polarity

The more polar the dye, the farther it will go up the paper



Paper Chromatography Terms (Know for Concept review)

Stationary phase: solid phase that is less polar (paper)

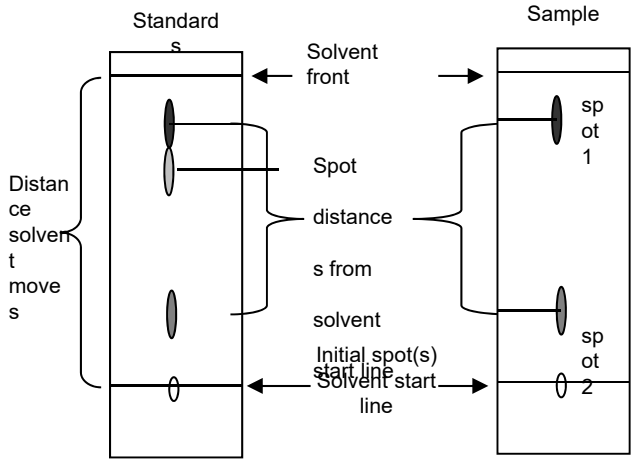
Mobile phase: liquid that travels up the paper and is more polar

Chromatogram: stationary phase after sample has been run

Solvent Front: Line designating furthest the solvent travels

Retention factor: Measurement of how far the dye travels

$$R_f = \frac{\text{Distance dye moves (mm)}}{\text{Distance solvent moves (mm)}} = \frac{\text{start line to spot (mm)}}{\text{start line to solvent front (mm)}}$$



Recitation

1. Calculate the R_f values for both your pens for both chromatograms
2. Fill out results table
3. Have your TA sign your results table before you leave