

N28 – Intermolecular Forces

Target: I can define and identify different types of Intermolecular Forces

N28 – Intermolecular Forces

An Introduction

Intermolecular Attractions

- **State of matter (s, l, g) determined by the strength of the attractions between the particles.**
- **At room temperature, moderate to strong attractive forces result in materials being solids or liquids.**
- **The stronger the attractive forces are, the higher the boiling point of the liquid and melting point of the solid.**
 - **Other factors also influence the melting point.**

Why are molecules attracted to each other?

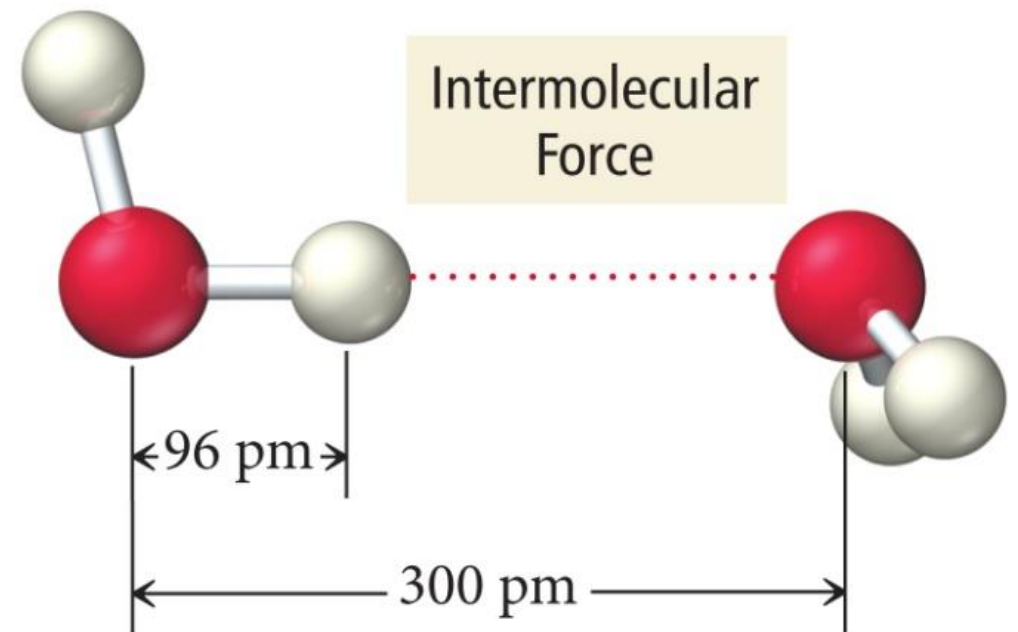
Intermolecular attractions are due to attractive forces between opposite charges.

+ ion to - ion

+ end of polar molecule to - end of polar molecule

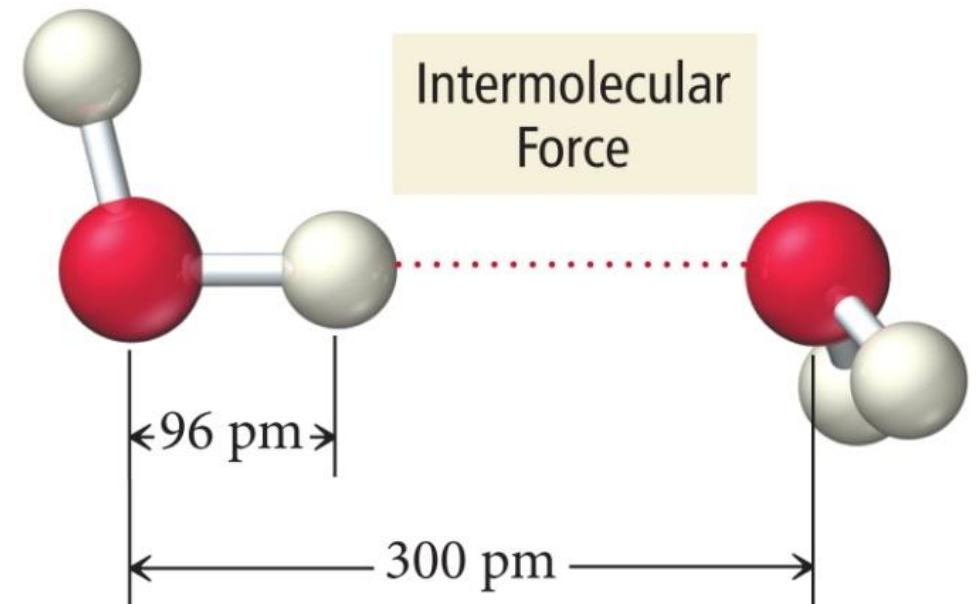
H-bonding especially strong

Even nonpolar molecules will have temporary charges



Why are molecules attracted to each other?

- **Larger charge = stronger attraction**
- **Longer distance = weaker attraction**
- However, these attractive forces are small relative to the bonding forces between atoms.
 - Generally smaller charges
 - Generally over much larger distances



Trends in the Strength of Intermolecular Attractions

The stronger the attractions between the atoms or molecules, the more energy it will take to separate them.

Trends in the Strength of Intermolecular Attractions

Boiling a liquid requires that we add enough energy to overcome all the attractions between the particles.

- However, not breaking the covalent bonds

Trends in the Strength of Intermolecular Attractions

- The higher the normal boiling point of the liquid, the stronger the intermolecular attractive forces.
- Normal BP happens when
vapor pressure = atmospheric pressure

Kinds of Attraction

London Dispersion Forces

Temporary polarity in the molecules due to unequal electron distribution leads to attractions

Kinds of Attraction

Dipole-Dipole Attractions

Permanent polarity in the molecules due to their structure leads to attractive forces

Kinds of Attraction

Hydrogen Bonds

An especially strong dipole–dipole attraction results when H is attached to an extremely electronegative atom [N,O,F].

Relative Magnitude of Forces

The types of bonding forces vary in their strength as measured by average bond energy.

Strongest



Network Covalent bonds 400 kcal/mol

Hydrogen bonding 12-16 kcal/mol)

Dipole-dipole interactions 2-0.5 kcal/mol

Weakest

London forces less than 1 kcal/mol

Practice

**What type of IMF is in
 H_2O ?**

Hydrogen Bonding

Practice

**What type of IMF is in
Ammonia?**

Hydrogen Bonding

Practice

**What type of IMF is in
HCl?**

Dipole-Dipole

Practice

**What type of IMF is in
CO₂?**

London Dispersion

Practice

**What type of IMF is in
CH₄?**

London Dispersion

Practice

**What type of IMF is in
Hydrogen Sulfide?**

Dipole-Dipole

YouTube Link to Presentation:

<https://youtu.be/KukAW2h1wI4>