

GENERAL CHEMISTRY

STANDARD 5.8

5.8: Differentiate among dipole-dipole forces, ion-dipole forces, hydrogen bonding, and London dispersion forces

INTERMOLECULAR FORCES

- **Intermolecular forces:** Weak forces of attraction or repulsion between neighboring particles that may be atoms, ions, or molecules.
 - The more polar the molecules, the stronger the intermolecular forces that exist to attract the molecules together
 - Also known as **van der Waal's forces**
- There are several types of intermolecular forces
 - Hydrogen Bonding
 - Dipole-Dipole Forces
 - Ion-Dipole Forces
 - London Dispersion Forces

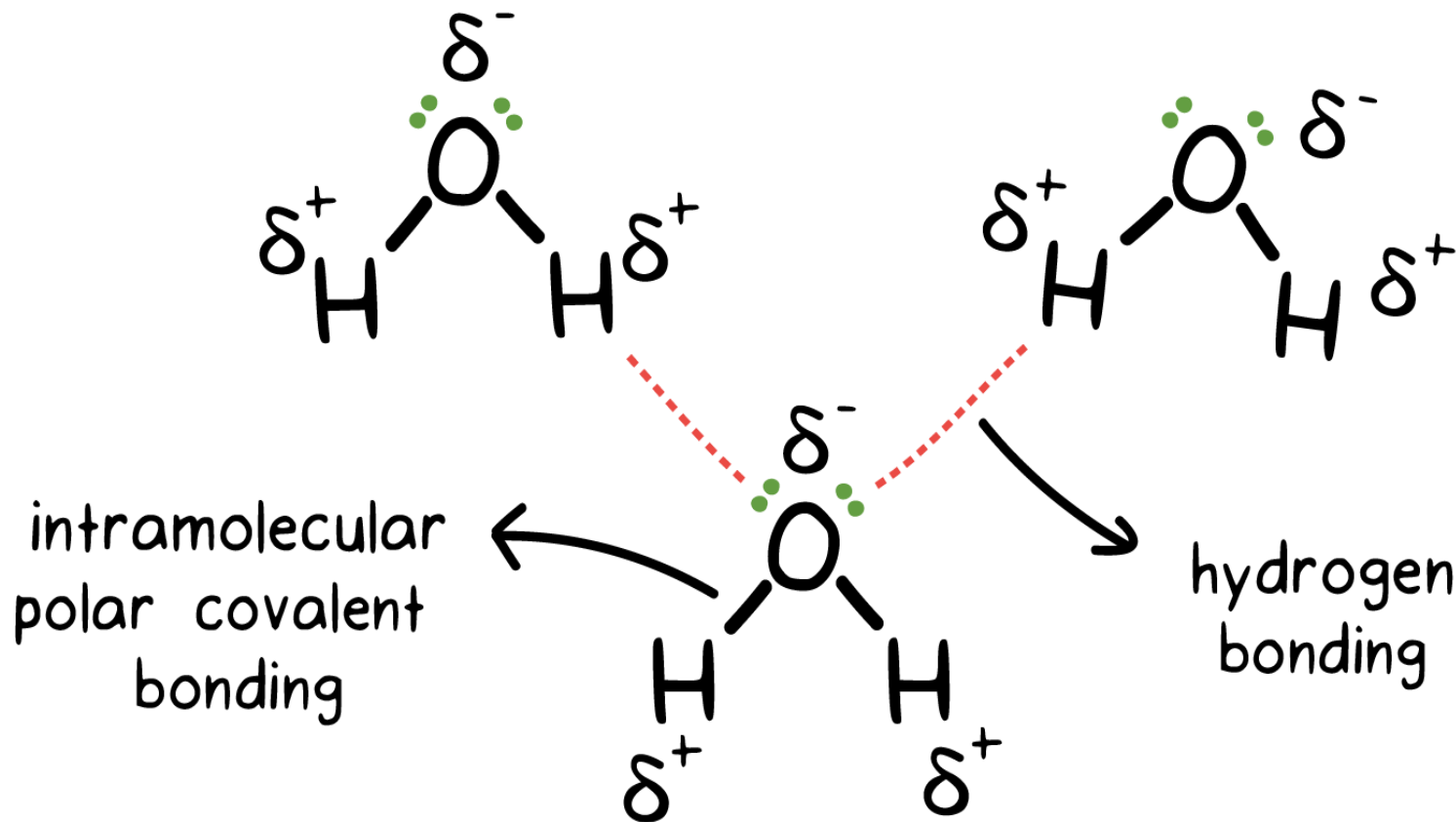
5.8: Differentiate among dipole-dipole forces, ion-dipole forces, hydrogen bonding, and london dispersion forces

HYDROGEN BONDING

- The strongest intermolecular force
 - Attractive force caused by hydrogen attracted towards one of following:
 - Fluorine
 - Oxygen
 - Nitrogen
 - The above compounds are highly electronegative elements with large unshared electron clouds, so hydrogen atoms partially share this electron cloud with the molecule next to it.

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HYDROGEN BONDING



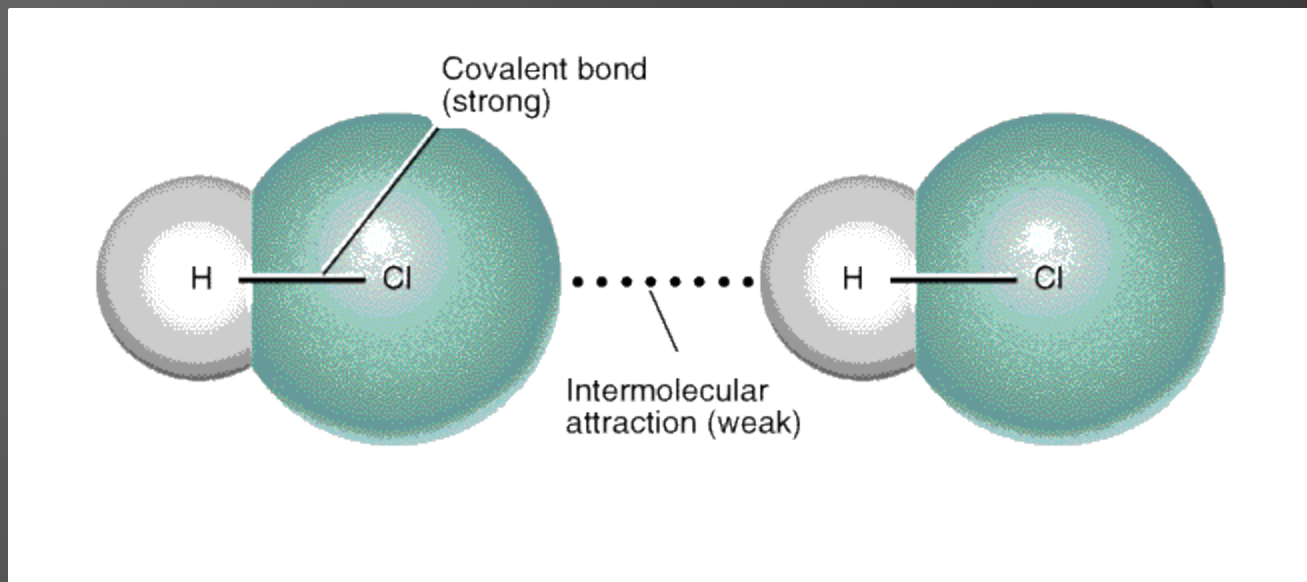
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DIPOLE-DIPOLE FORCES

- **Dipole Moment:** Molecules that are polar, which means that one end of the molecule has a different charge, albeit very small, than the other side of the molecule, creating a polarized molecule with a “north” and a “south” pole, or positive and negative ends.
 - Just because a molecule has a polar bond does not automatically mean the molecule is polar!
 - Must consider geometry
 - Polar molecules may cancel each other out
- Polar molecules will be attracted each other, opposite end to opposite end
 - Slightly negative end will be attracted to slightly positive end
 - Slightly positive end will be attracted to slightly negative end
- The second strongest intermolecular force

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DIPOLE-DIPOLE FORCES



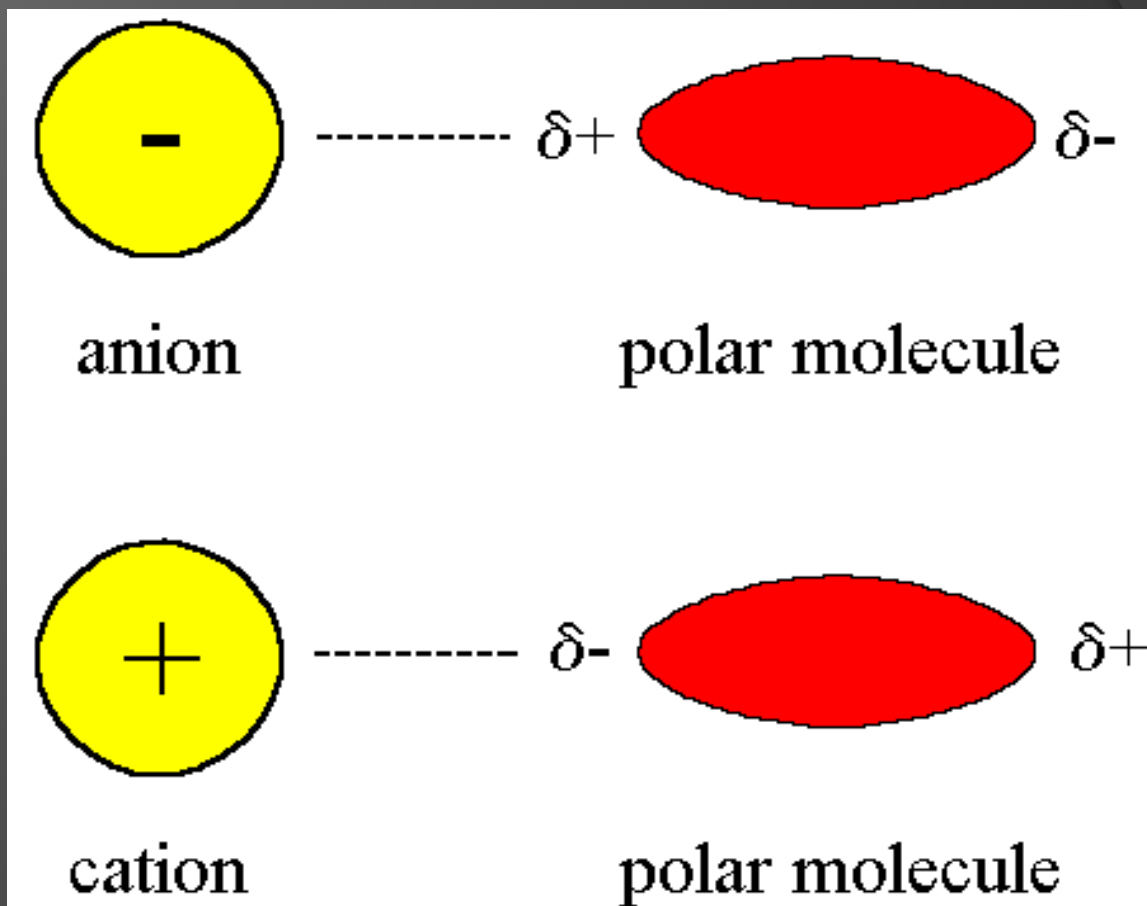
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ION-DIPOLE FORCES

- An ion can also be attracted to a dipole moment (polar molecule)
 - Cation will be attracted to slightly negative end of dipole
 - Anion will be attracted to slightly positive end of dipole
- The third-strongest (and second-weakest) intermolecular force

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ION-DIPOLE FORCES

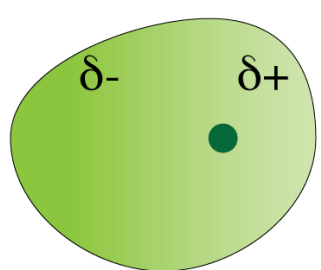


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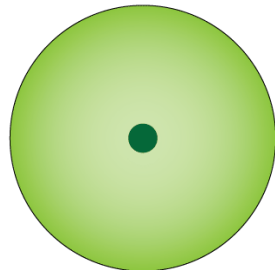
LONDON DISPERSION FORCE

- **London Dispersion Force:** A temporary attractive force that results when the electrons in two adjacent atoms occupy positions that make the atoms form temporary dipoles, and the temporary dipoles are attracted to each other in a weaker version of the dipole-dipole force.
 - The weakest intermolecular force
 - Stronger effect on larger molecules
 - The larger the molecules involved become, the larger the London Dispersion Forces attract the molecules together

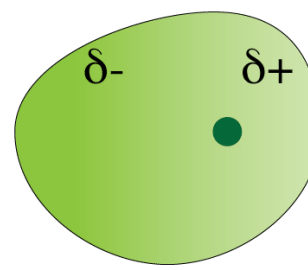
LONDON DISPERSION FORCE



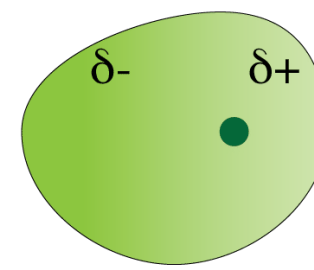
Instantaneous uneven distribution of electrons in He atom



Nonpolar He atom



Instantaneous dipole



Induced dipole on neighboring He atom. Resultant attractive force

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EXAMPLE PROBLEMS

- Identify the dominant intermolecular force for the following molecules:
 - C_3H_8
 - HCl
 - MgO
 - $NaCl$
 - O_2
 - CO_2
 - H_2O

EXAMPLE PROBLEM SOLUTIONS

- Identify the dominant intermolecular force for the following molecules:

• C_3H_8	Dispersion
• HCl	Dipole-Dipole
• MgO	Dipole-Dipole
• NaCl in Water	Ion-Dipole
• O_2	Dispersion
• CO_2	Dispersion
• H_2O	Hydrogen Bonding