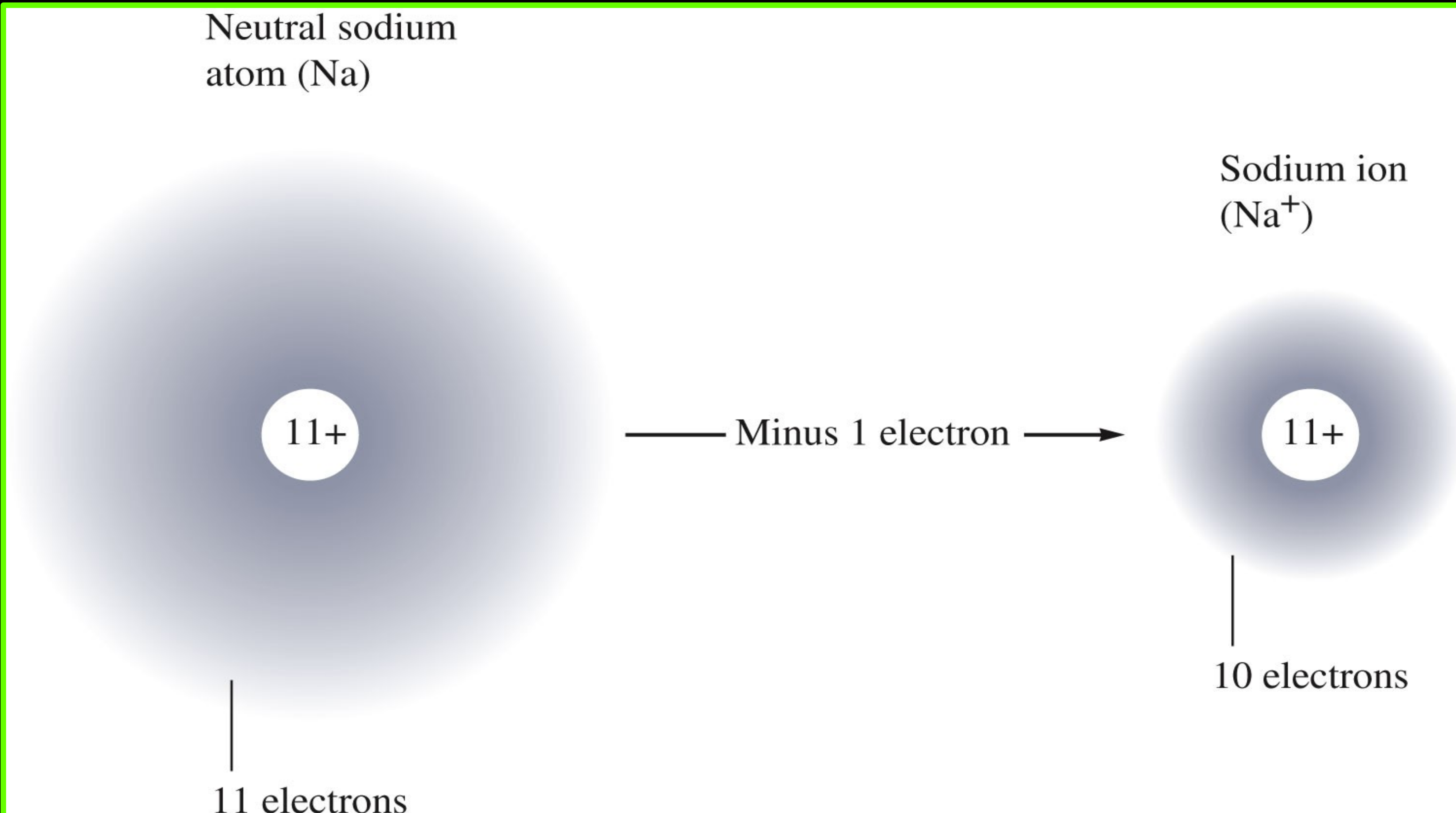
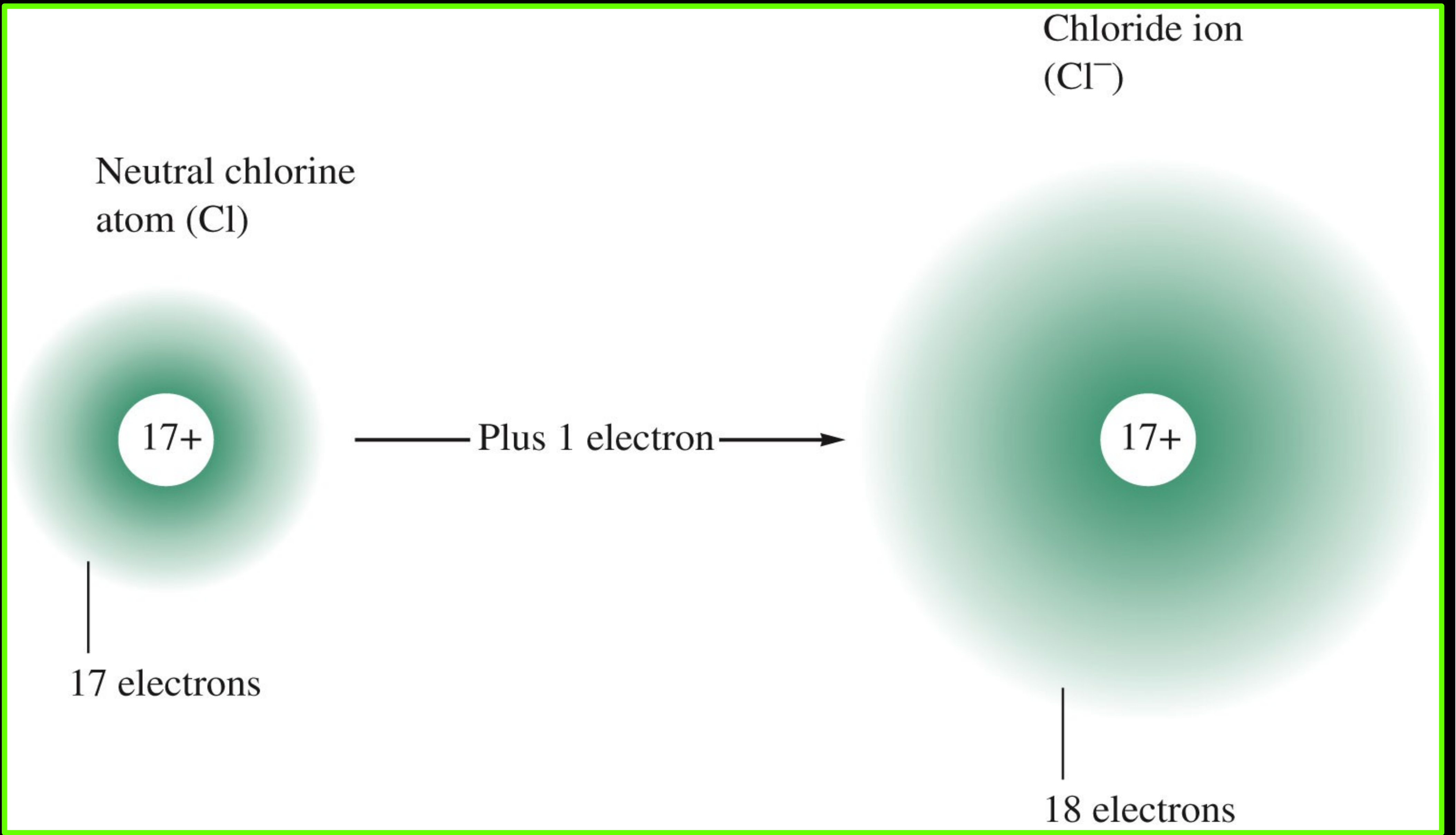
Compounds and Their Bonds

Chapter 5

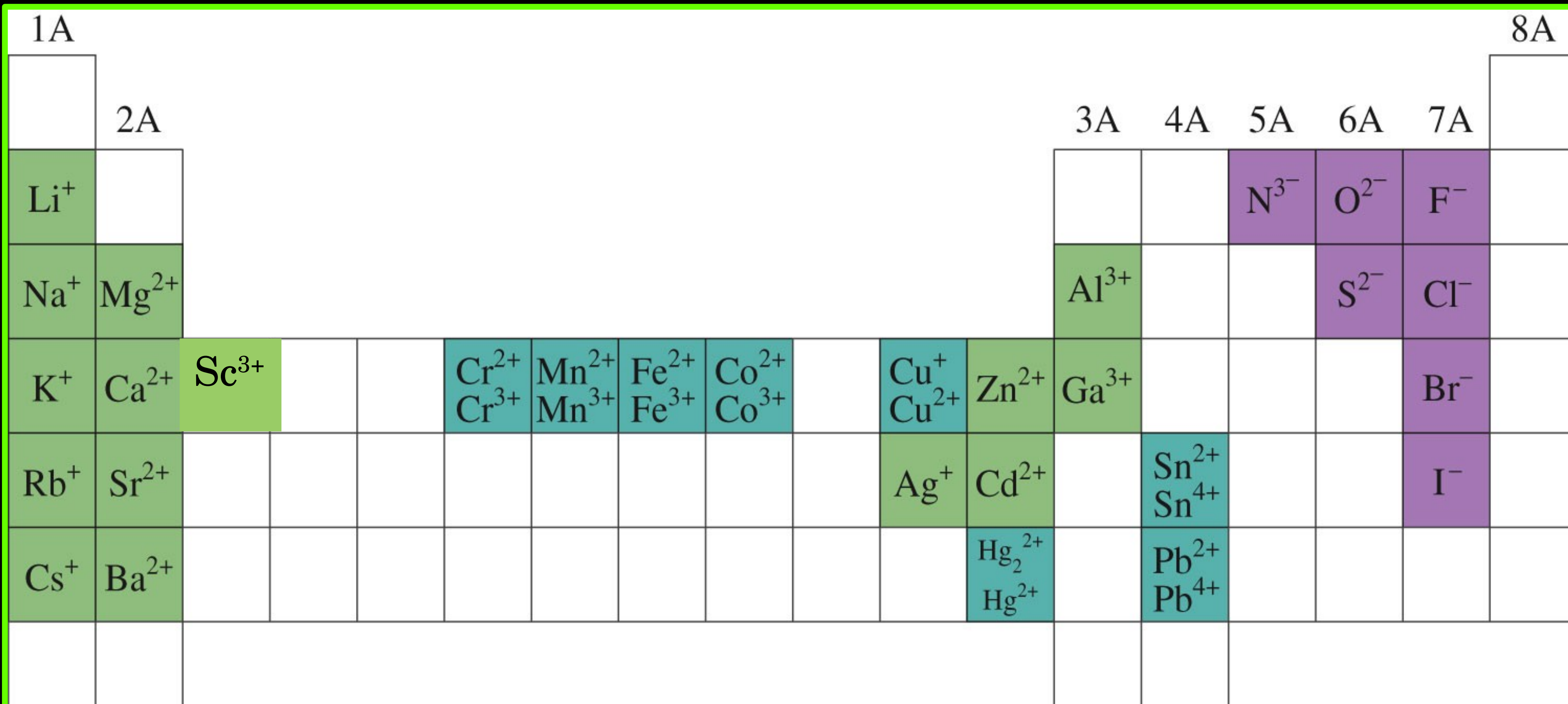
Atoms gain or lose electrons to form ions. Cations are formed when electrons are lost.



Anions are formed when electrons are gained.



Some elements always form the same ions, some don't.



MEMORIZE THE GREEN AND PURPLE ONES.

The octet rule explains why atoms gain or lose electrons.

Atoms gain, lose, or share valence electrons in order to have the same number of electrons as the nearest (in atomic number) noble gas.

The formula for an ionic compound makes sure the number of positive charges is equal to the number of negative charges.

KCl, $CaBr_2$, Al_2O_3

The symbol for an element is it's formula, except:

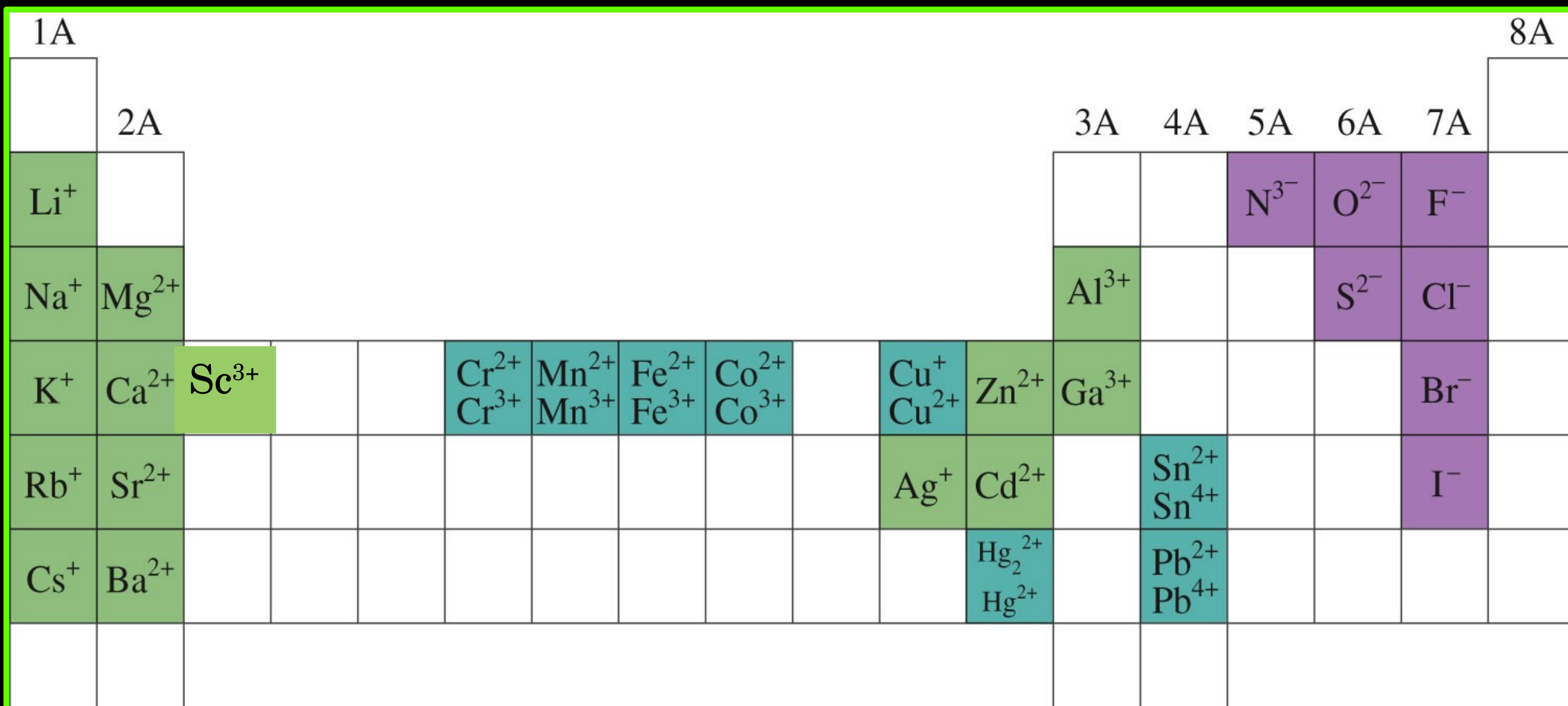
HOFBrINCl

The name of a cation is the name of the element unless:

The element can form more than one cation.

Then we must use a Roman numeral to say what the charge on that cation is.

How do we know if an element (metal) can form more than one cation?



The name of an anion is the name of the element with it's ending changed to “ide”

Cl^{-}, O^{2-}, N^{3-}

Binary Ionic Compounds

One metal element and one nonmetal element.

The cation is the first element, the anion is the second.

The name of a binary ionic compound is:

Name of cation + name of anion

Binary Molecular Compounds

2 nonmetal elements.

The name of a binary molecular compound is:

Name of first element, then name of second element, ending changed to “ide”

Use prefixes.

Memorize table 12 pg. 182

No “mono” for first element

Ternary Ionic Compounds

3 or more different elements in the compound.

The cation (usually a metal, but could be a polyatomic ion), is written first.

The anion (usually a polyatomic ion) is written second.

The name of a ternary ionic compound is:

Name of cation + name of anion

Memorize table 7 pg. 171
+
8 OTHERS

BrO^-	hypobromite
BrO_2^-	bromite
BrO_3^-	bromate
BrO_4^-	perbromate
IO^-	hypoiodite
IO_2^-	iodite
IO_3^-	iodate
IO_4^-	periodate

If the anion contains oxygen, then the ending changes.

If the anion in an acid contains oxygen change the ending of the polyatomic ion:

"ate" to "ic"
"ite" to "ous"

Then say the name of the polyatomic ion with the changed ending followed by "acid"

If the name of the anion in an acid ends in "ide" just fill in the blank.

Acids have one, two, or three H^+ ions written first in the formula.

The rest of the formula is an anion.

When the name of the anion ends in "ide" the name of the acid is:

Hydro________ic acid

Here the root of the anion fills in the blank.

Hydrates have water molecules in them, but are solids.

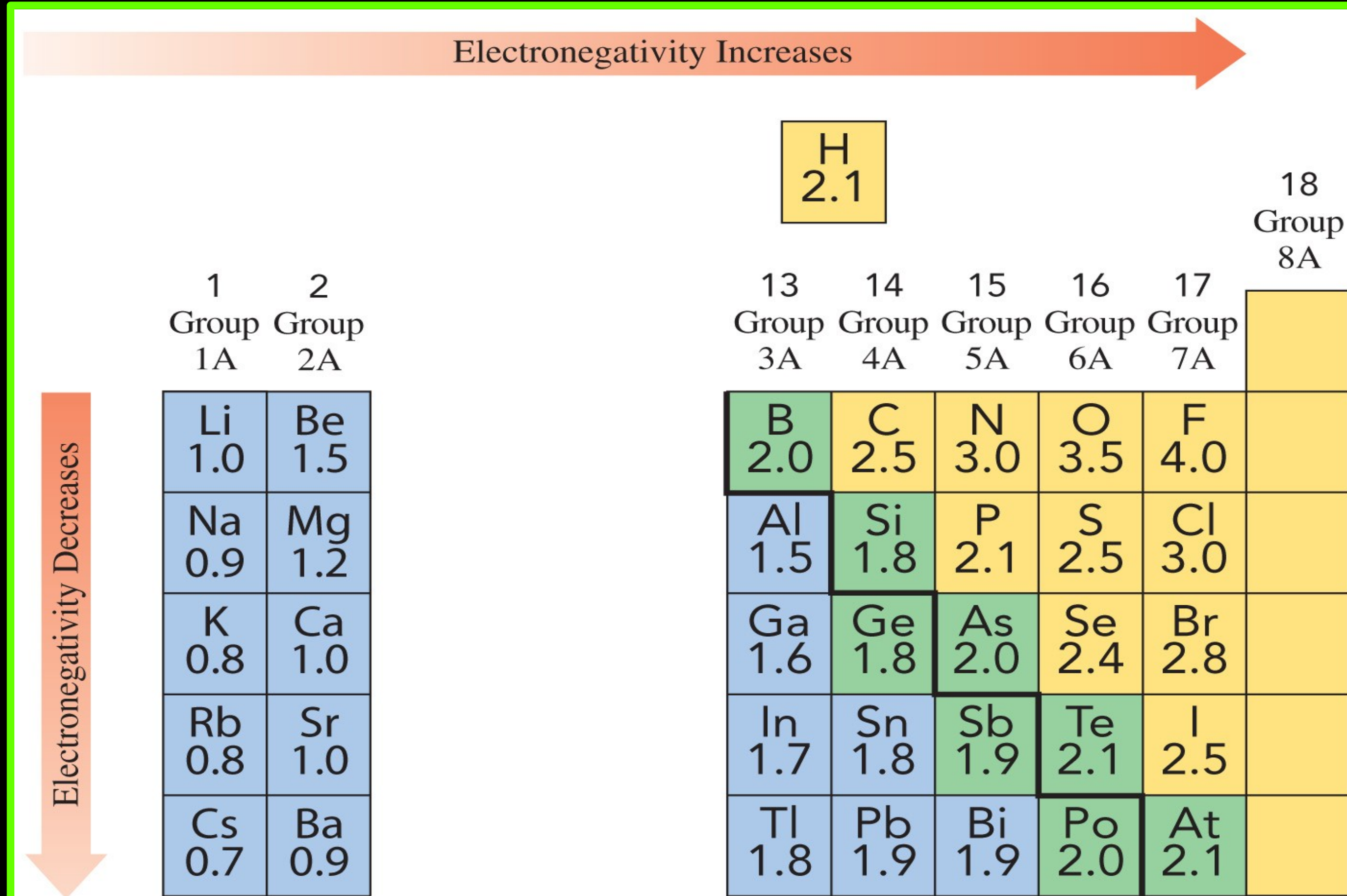
$$SrCl_2 \cdot 6H_2O$$

Say the name of the ionic compound

Say the number in front of the "H_2O" using the same prefixes we used in binary molecular compounds.

Say Hydrate

Electronegativity is the strength with which an atom pulls electrons in a bond towards itself.

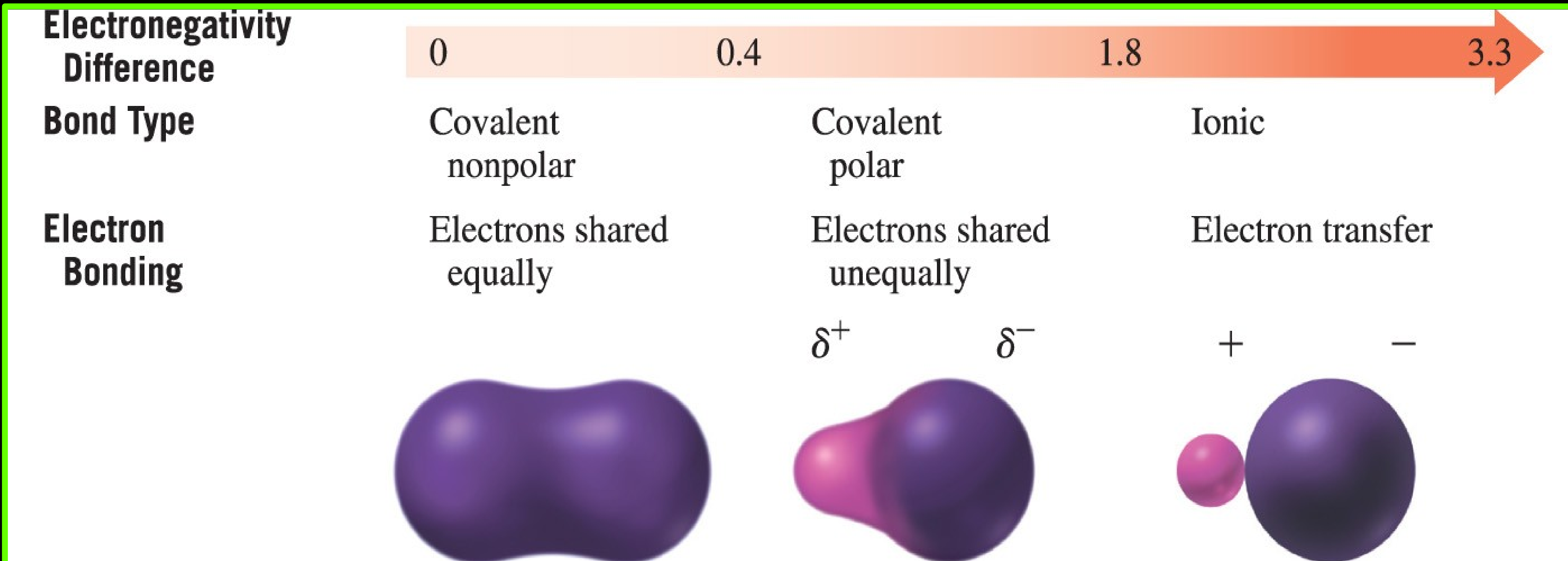


MEMORIZE

H, Li → F,

F → I

There are nonpolar covalent, polar covalent, and ionic bonds.



For example: H-F, C-O, C-H, P-Br

Lewis structures tell us how the atoms in a compound are connected.

To draw a Lewis structure follow this procedure:

Count up the total valence electrons in the molecule.

- Add one electron for each negative charge.
- Subtract one electron for each positive charge.

Let's look at the sulfate polyatomic ion: SO_4^{2-}

32 valence electrons

Arrange the atoms

- The least electronegative in the center
- Hydrogen is NEVER in the center.

O

O S O

O

Connect the outer atoms to the central atom with single bonds, subtracting 2 electrons from the total in the first step for each single bond formed.

32 – 8 = 24 electrons left.

Satisfy the octet rule for the outer atoms, subtracting each electron used from the total in step 1.

Any remaining electrons go on the central atom.

If you run out of electrons before all atoms have the octet rule satisfied, use double or triple bonds to satisfy the octet rule.

There are exceptions to the octet rule applied to Lewis structures.

Incomplete Octets

- Be — 4 valence electrons
- B — 6 valence electrons

Odd Numbers of Electrons

- Free Radicals

Expanded Octets

Resonance forms exist when more than one Lewis structure can be drawn.

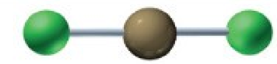
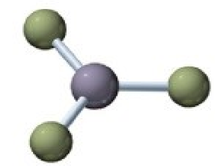
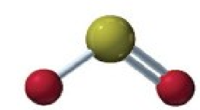
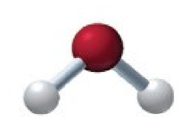
Resonance structures are equivalent Lewis structures that differ only in the location of electrons.

Only 1 true structure exists, a hybrid of resonance forms.

VSEPR Theory lets us predict the shapes of molecules.

Memorize table 16 pg. 191.
This lets us predict shapes of molecules.

MEMORIZE

Electron Groups	Electron-Group Arrangement	Bonded Atoms	Lone Pairs	Bond Angle	Molecular Shape	Example	Three-Dimensional Model
2	**Linear**	2	0	180°	Linear	$BeCl_2$	
3	**Trigonal planar**	3	0	120°	Trigonal planar	BF_3	
		2	1	120°	Bent	SO_2	
4	**Tetrahedral**	4	0	109°	Tetrahedral	CH_4	
		3	1	109°	Trigonal pyramidal	NH_3	
		2	2	109°	Bent	H_2O	

A molecule can be polar (if it has polar bonds) or nonpolar (if it has polar or nonpolar bonds).

To determine if a molecule is polar or not, ask yourself if all of the outer atoms are the same as each other or not.

Draw the Lewis structure. If all of the outer atoms are the same as each other:

The molecule is polar only if the shape of the molecule is either **bent** or **trigonal pyramidal** **and** the bonds are polar.

If the shape is anything else (and all the outer atoms are the same as each other) or the bonds are nonpolar the molecule is nonpolar.

If all of the outer atoms are not the same as each other:

The molecule is polar if at least one of the bonds is polar.

If none of the bonds is polar the molecule is nonpolar.

INTERMOLECULAR (I.M.) FORCES

Dispersion (London, Induced Dipole)

Dipole – Dipole

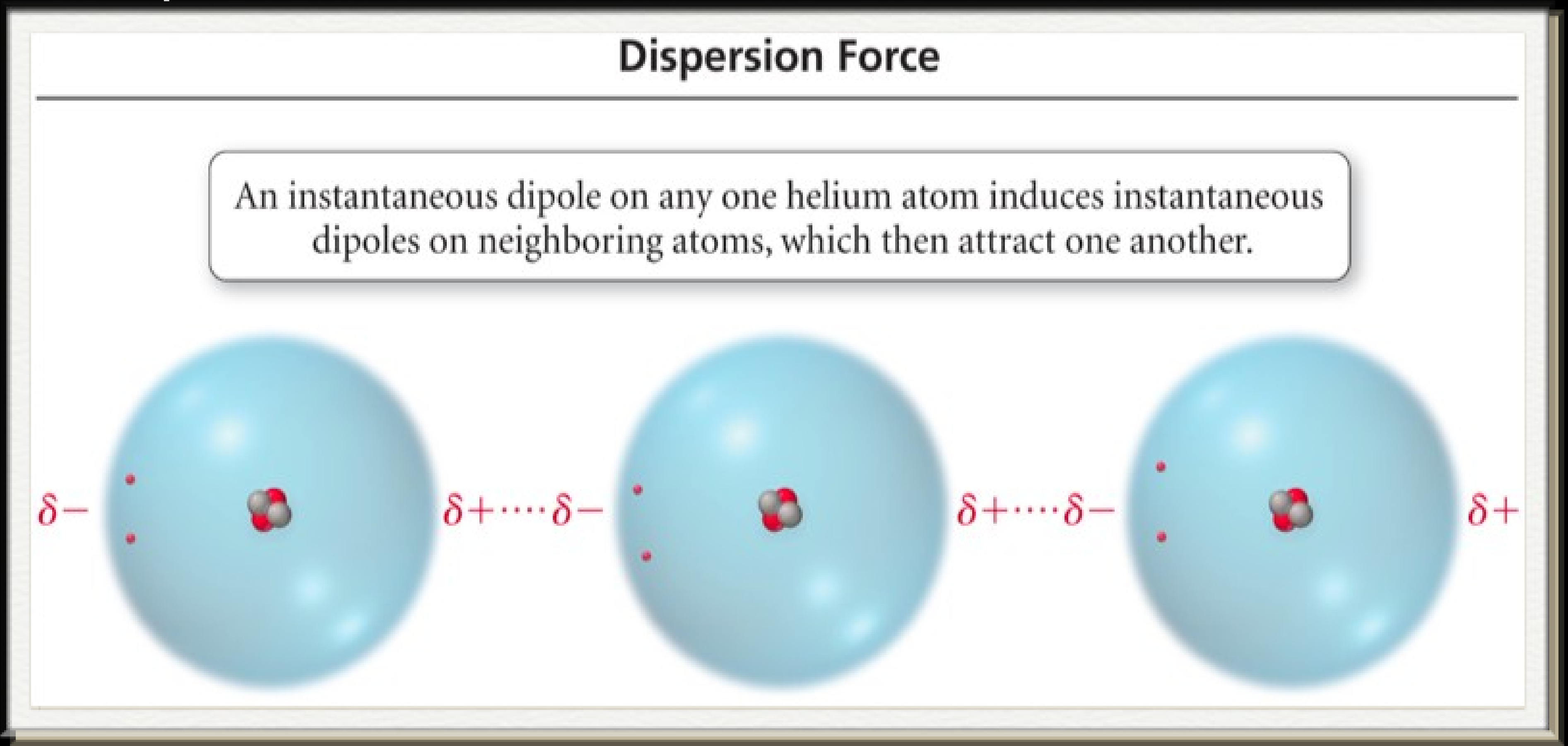
Hydrogen Bonding

DISPERSION FORCES

All molecules/atoms have these

The weakest of the 3 types of I.M. forces.

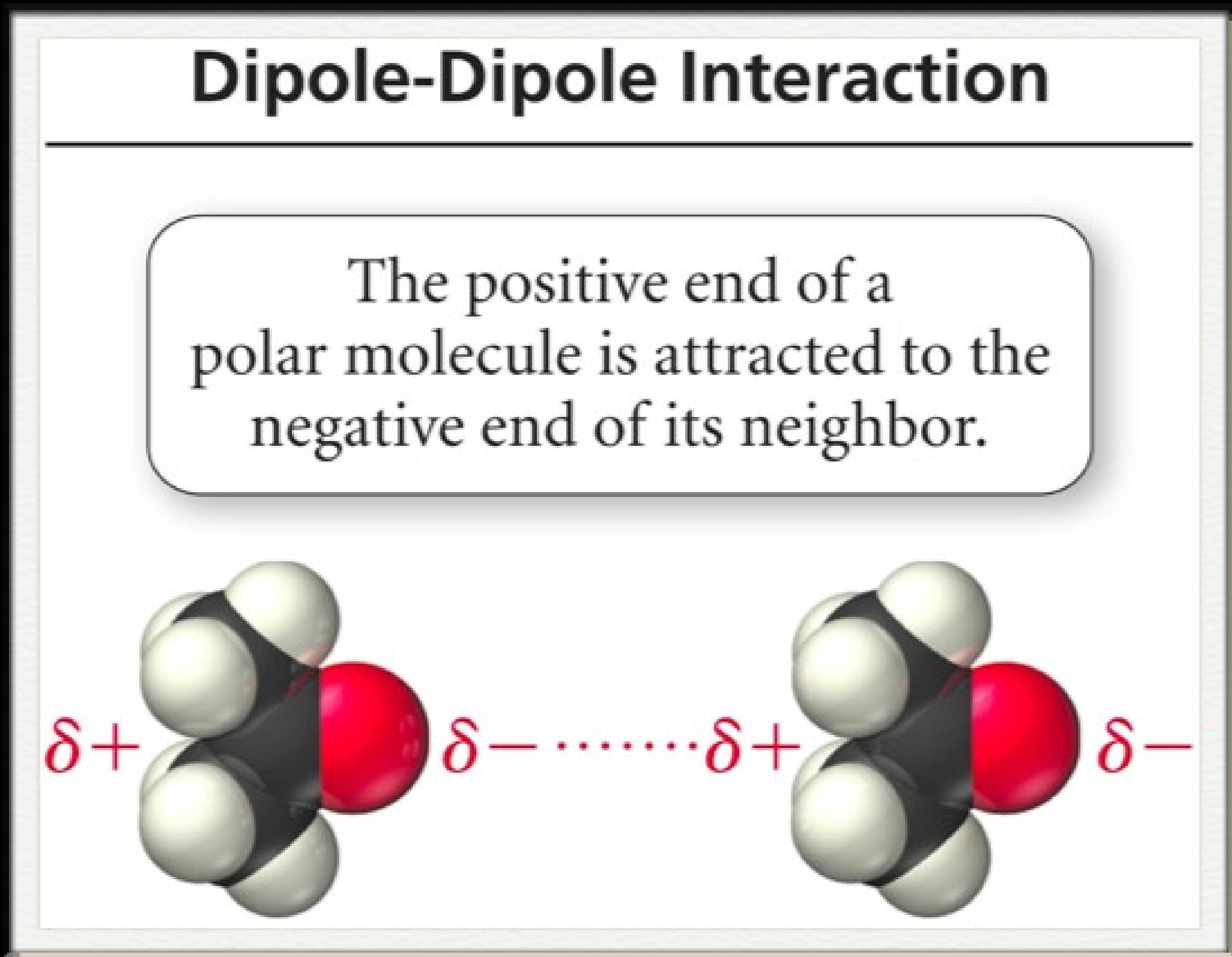
Increased molar mass means increased strength of dispersion forces.



DIPOLE-DIPOLE FORCES

Only exist in polar molecules.

Stronger than dispersion forces, weaker than H-bonds.



H-BONDS

NOT a bond!

Only exists when there is a H-atom DIRECTLY attached to a N, O, or F atom.

Strongest of the I.M. forces.

H-BONDING