

Bonding

What are **bonds**?

Ionic bonding

Covalent Bonds

NAMING!!!

(MHR Chemistry 11, Section 2.2)



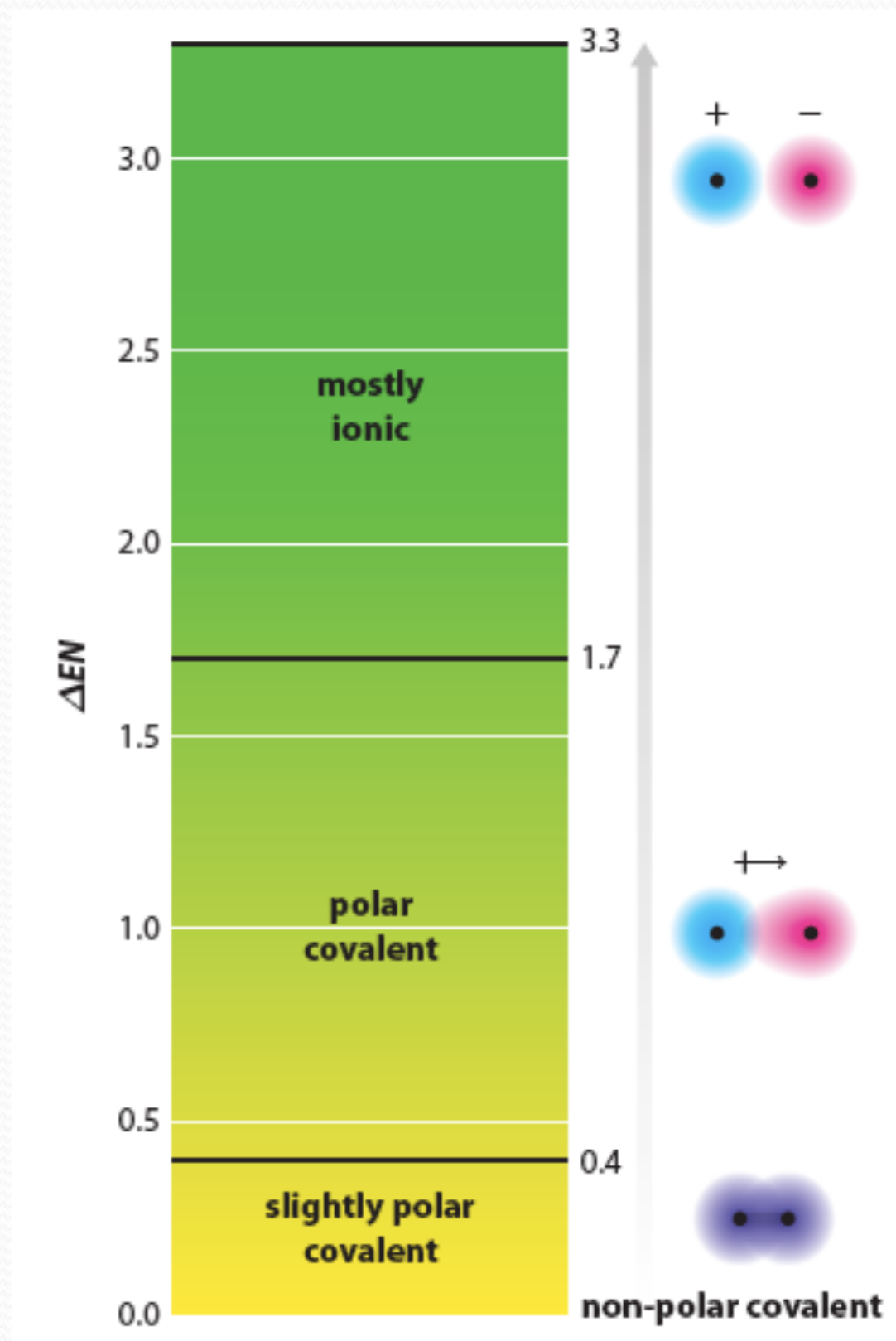
Chemical Bonds

Bonding

- **Bonds are formed between atoms by the transfer or sharing of electrons**
- **Atoms acquire stable octets by forming bonds (8 electrons). The exception is hydrogen (only 2 e⁻)**
- **Types of bonding:**
 - **Ionic – metal & non-metal**
 - **Covalent – non-metal & non-metal**

Electronegativity Difference

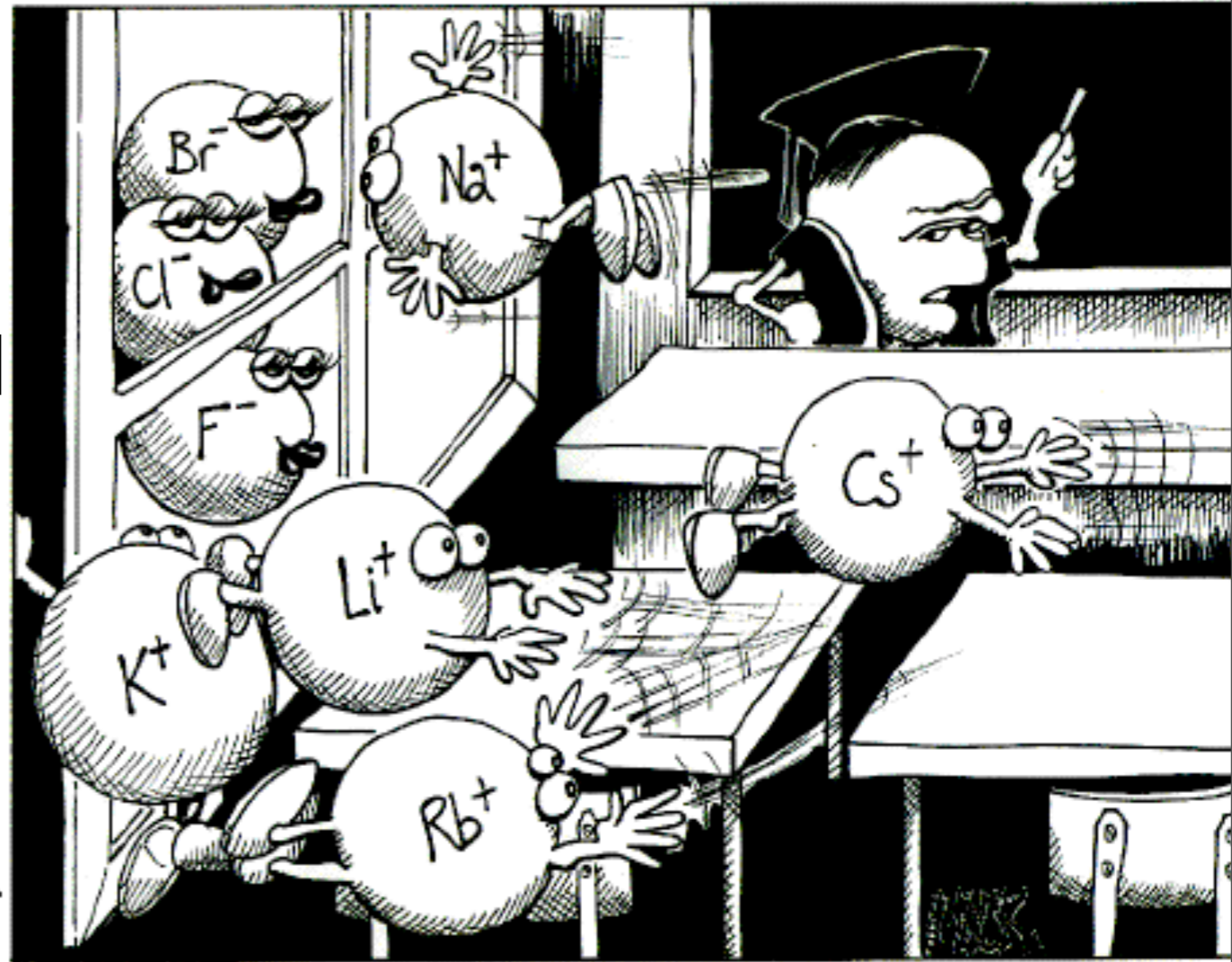
- How do we know if a bond will be ionic or covalent?
- Use Electronegativity values!
- If the difference is greater than 1.7, the bond is IONIC!



Ionic Bonding

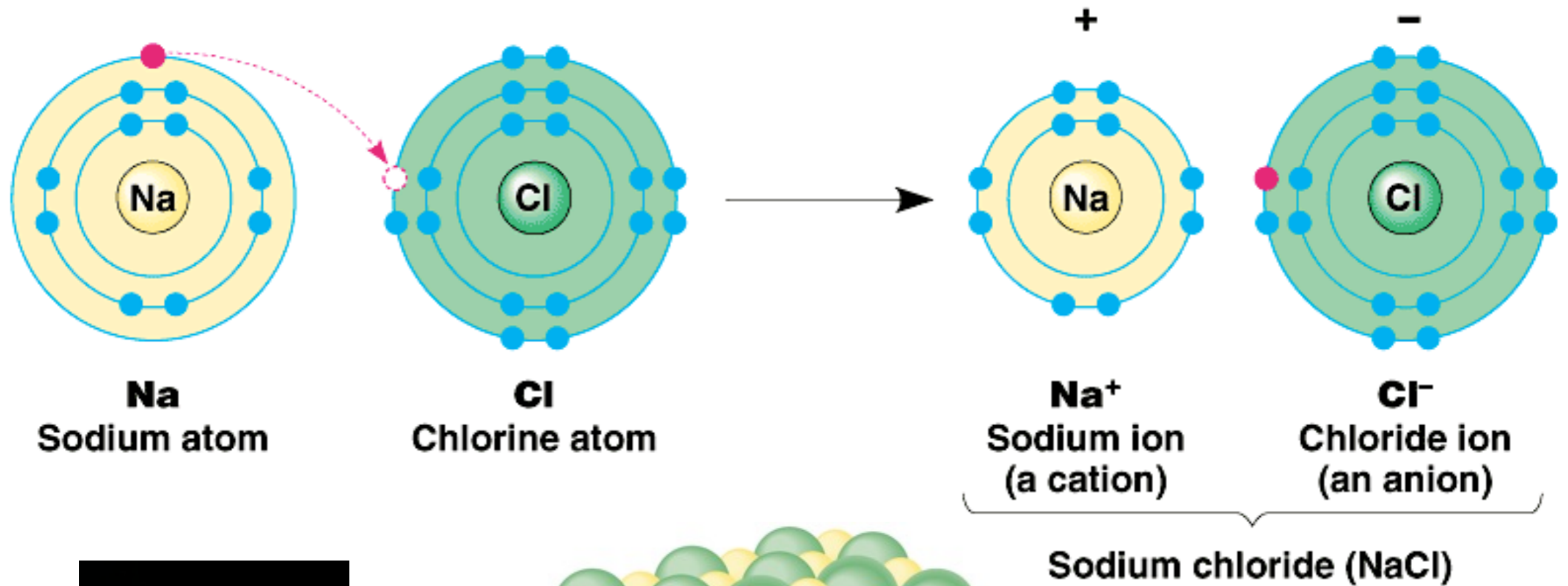
- Occurs between a Metal and Non-metal
- Transfer of electrons causes ions to be formed
- “Bond” is an electrostatic attraction between ions
- Difference in electronegativity more than 1.7 between elements

copyright Nick Kim
<http://strangematter.sci.waikato.ac.nz/>

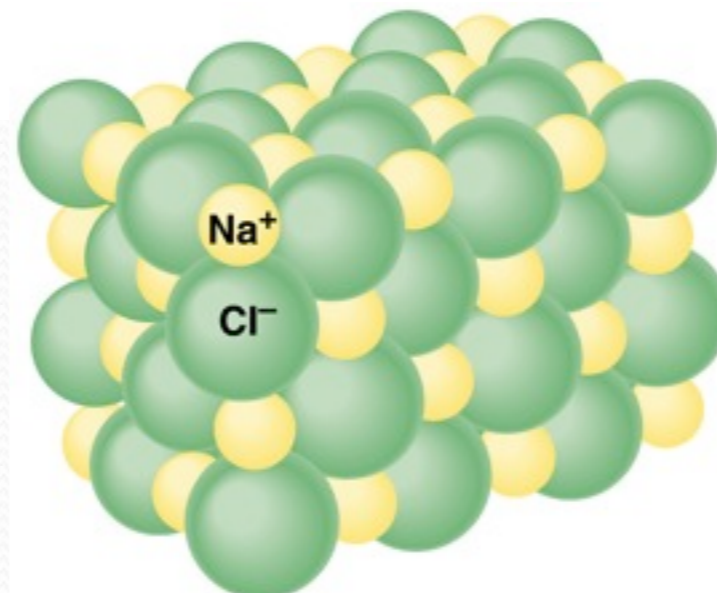


“Perhaps one of you gentlemen would mind telling me just what it is outside the window that you find so attractive...?”

Ionic Bonds – occur when one atom **donates** or **gives up** one or more electrons



Salt crystals

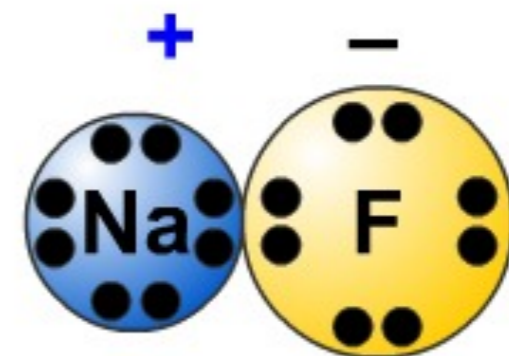
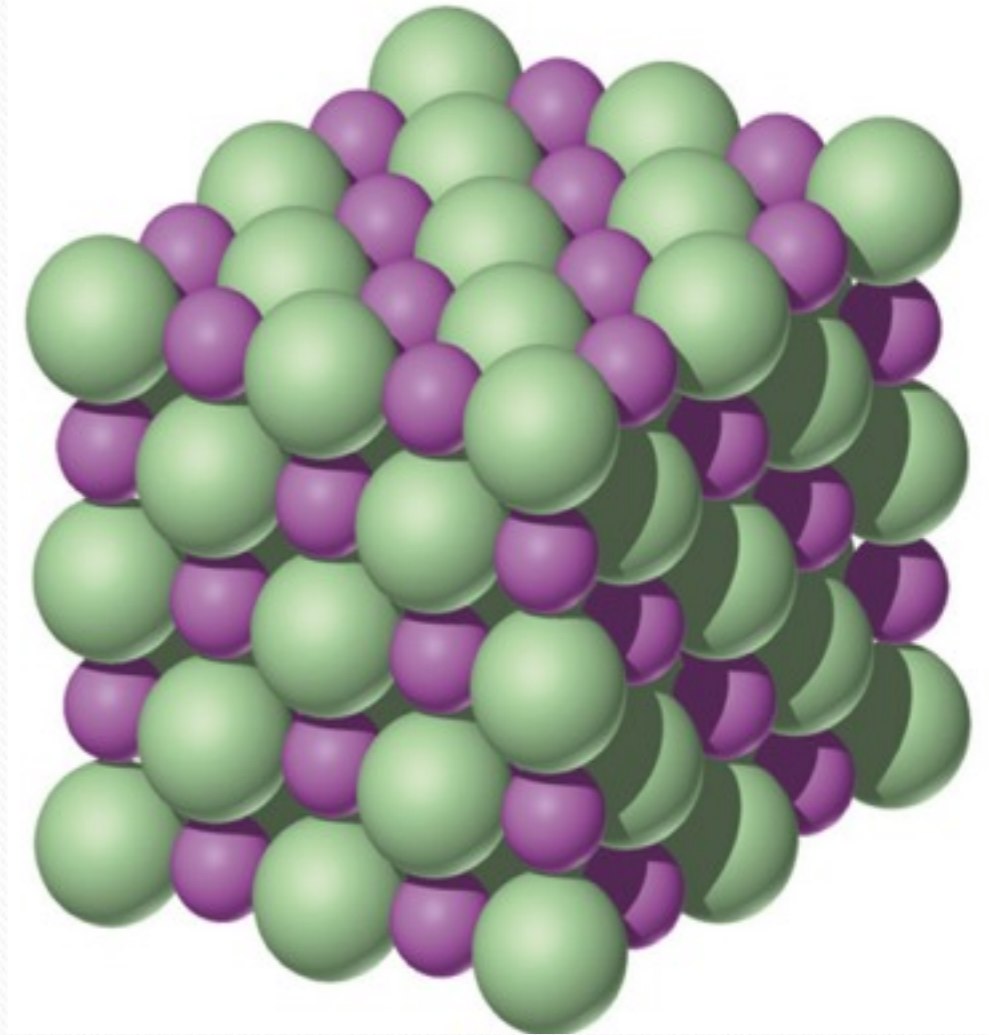


Ionic Compound (Na⁺Cl⁻)

Opposite
charges
attract to form
ionic bonds

Ionic Bonding

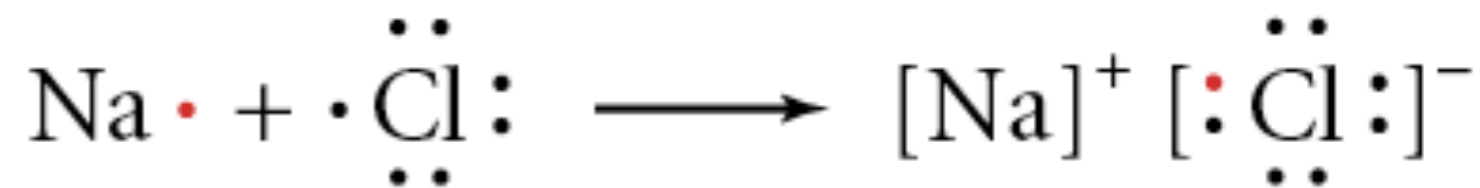
- Ionic bonds such as NaCl do not consist of just one Na^+ ion bonded to one Cl^- ion
- Ionic bonds represent the relative ratios of these ions in a huge lattice of thousands or millions of ions (i.e. – if there are 5,000 Na^+ ions, there are 5,000 Cl^- ions)



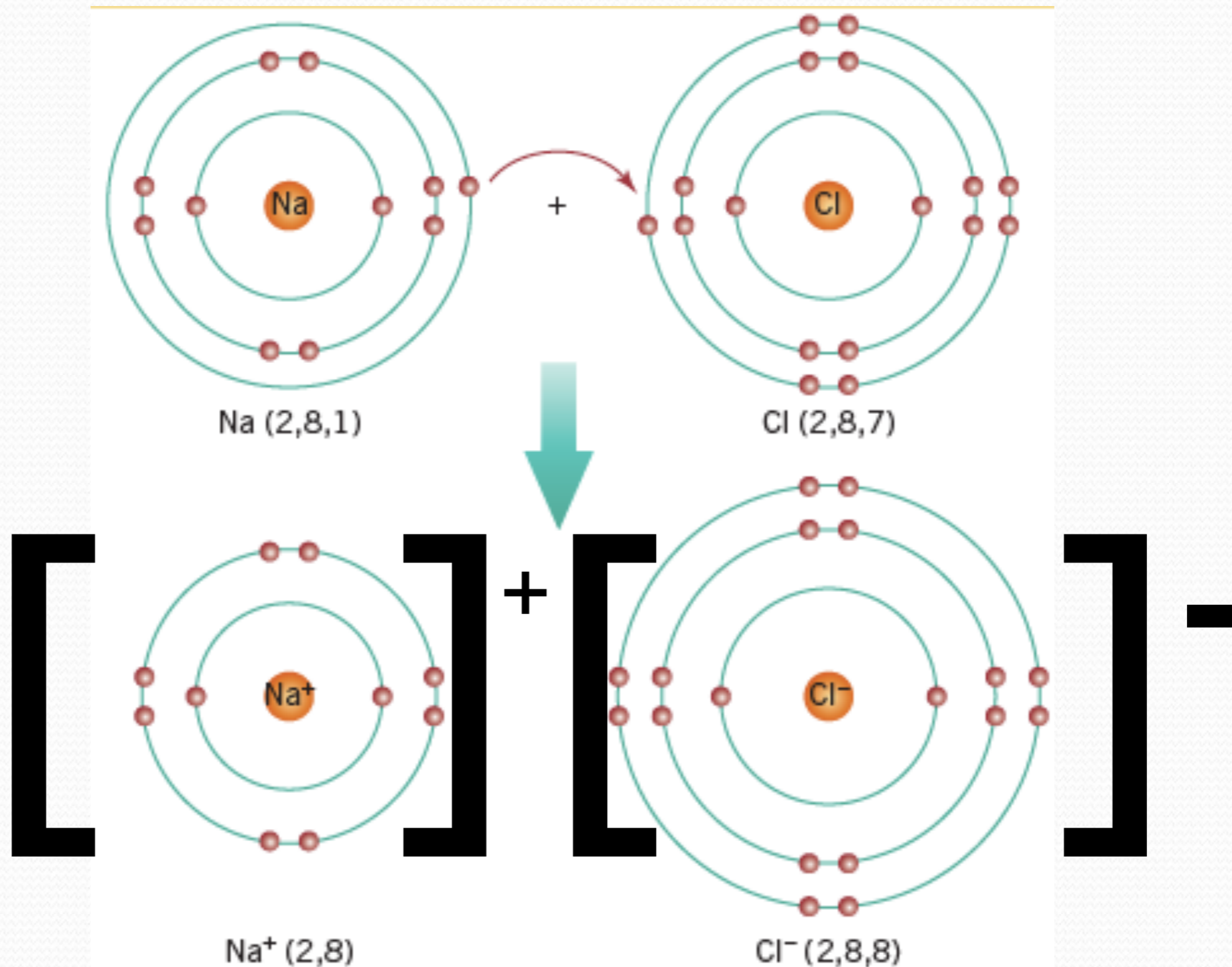
Drawing Lewis Structures of Ionic Compounds

- Ionic bonds are electrostatic attractions between cations and anions.
- Square brackets must be used around each ion, with charges on the top right hand corner
- Binary ionic compounds
 - Count electrons for each element
 - Transfer electrons accordingly to satisfy octet
- Ternary ionic compounds
 - Draw Lewis structures for polyatomic ions using covalent rules
 - Combine with other half

Example

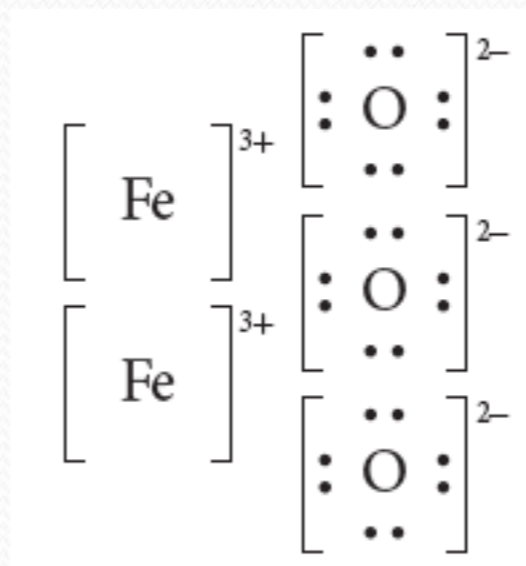
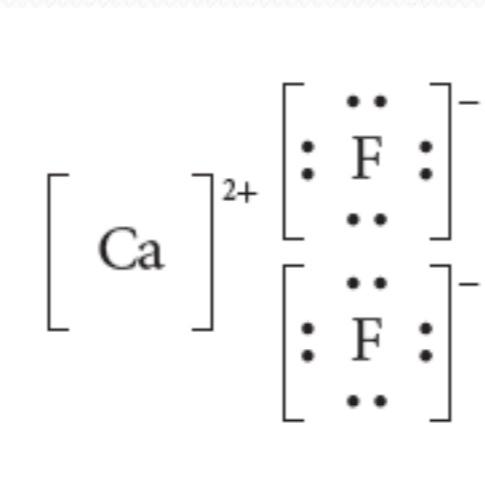


- NaCl



Try it!

- Draw Lewis structures to explain the bonding between:



Naming Ionic Compounds

Rules for Naming Binary Ionic Compounds

1. The name of the metal ion is first, followed by the name of the non-metal ion.
2. The name of the metal ion is the same as the name of the metal atom.
3. If the metal is a transition metal, it might have more than one possible charge. In these cases, a roman numeral is written in brackets after the name of the metal to indicate the magnitude of the charge.
4. The name of the non-metal ion has the same root as the name of the atom, but the suffix is changed to *-ide*.



Calcium fluoride



Iron (II) oxide



Iron (III) oxide

Add in some Polyatomics!

Sodium nitrate

NaNO_3

Relative Number of Oxygen Atoms		Prefix	Suffix		Example
Family of Four					
most	+1	per-	-ate	ClO_4^-	perchlorate
second most	NORMAL	(none)	-ate	ClO_3^-	chlorate
second fewest	-1	(none)	-ite	ClO_2^-	chlorite
fewest	-2	hypo-	-ite	ClO^-	hypochlorite
Family of Two					
most		(none)	-ate	NO_3^-	nitrate
fewest		(none)	-ite	NO_2^-	nitrite

- Sodium perchlorate
- Magnesium chlorate
- Lithium chlorite
- Calcium hypochlorite

NaClO_4

$\text{Mg}(\text{ClO}_3)_2$

LiClO_2

$\text{Ca}(\text{ClO})_2$

What about acids/bases?

- Acids and bases have a special naming system.
- Acids that don't have oxygen in them are called BINARY acids.
- HCl(aq) is hydrochloric acid

Pure Substance (name)	Formula H(negative ion)(aq)	Classical Name hydro(root)ic acid	IUPAC Name aqueous hydrogen (negative ion)
hydrogen fluoride	HF(aq)	hydrofluoric acid	aqueous hydrogen fluoride
hydrogen cyanide	HCN(aq)		
hydrogen sulfide	H ₂ S(aq)		

Oxoacids

- Any acid that has oxygen in it
- Named for the polyatomic ion in it
- H_2SO_4 is **sulfuric acid**
- Don't forget if we change the oxygens!

Examples	
Name of Ion	Name of Acid (dissolved in water)
hypochlorite, ClO^-	hypochlorous acid, HClO
chlorite, ClO_2^-	chlorous acid, HClO_2
chlorate, ClO_3^-	chloric acid, HClO_3
perchlorate, ClO_4^-	perchloric acid, HClO_4

Try it!

8. Write the names and chemical formulas for the compounds containing the following.

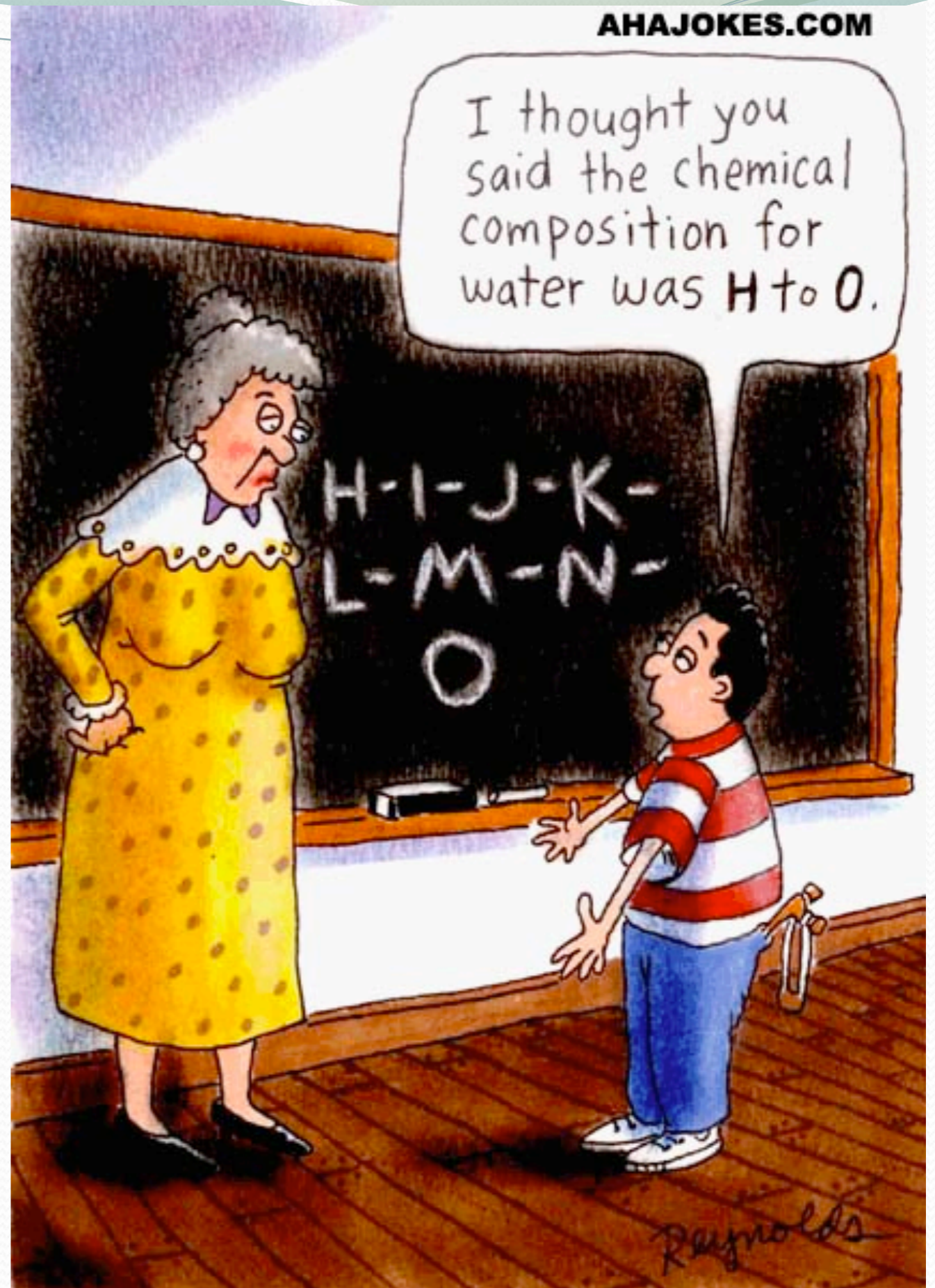
- a.** potassium and sulfur
- b.** oxygen and magnesium
- c.** chlorine and iron
- d.** magnesium and nitrogen
- e.** hydrogen and iodine
- f.** calcium and hydroxide ion

9. Write the name of each compound.

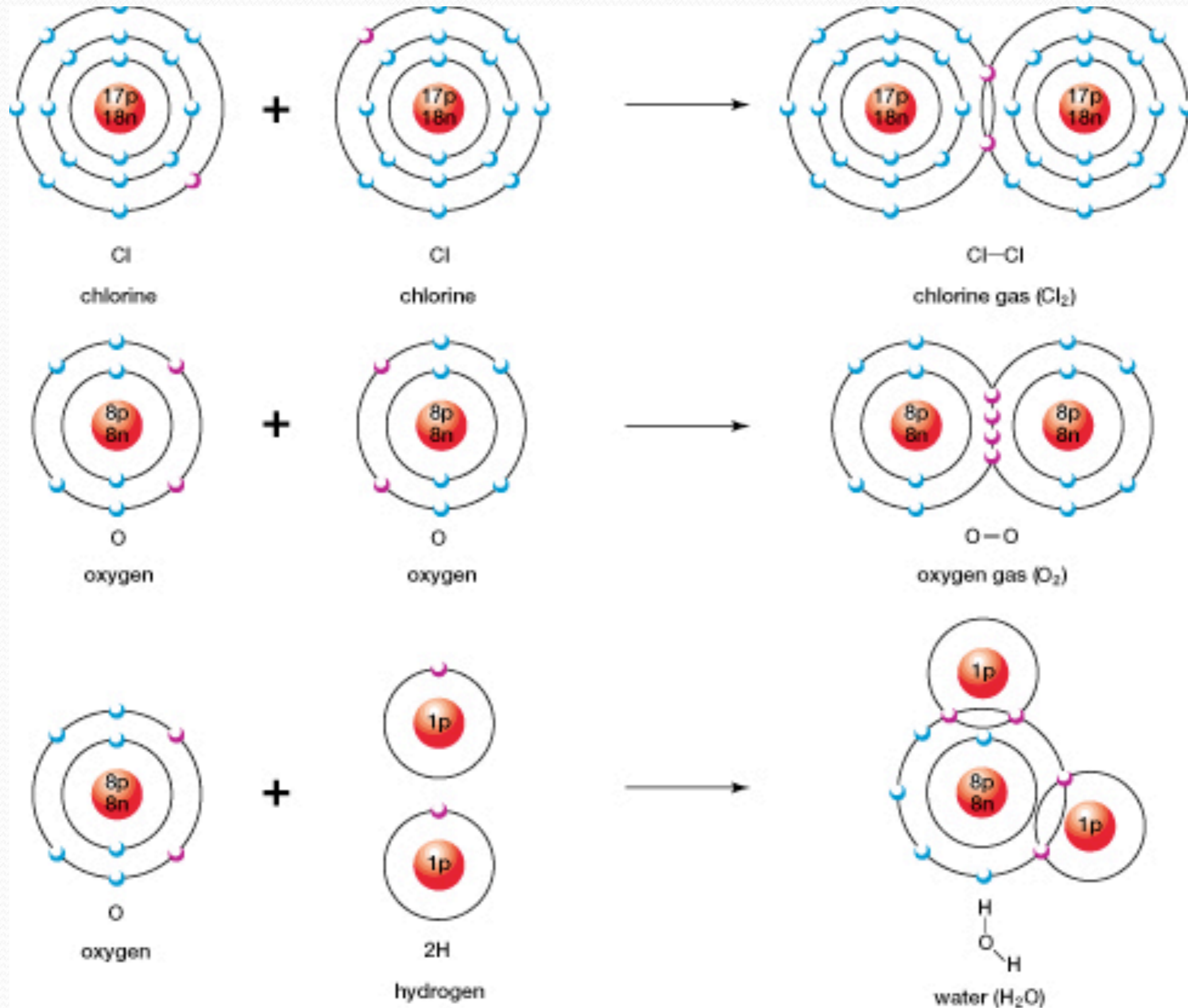
- | | | |
|---------------------------------|--------------------------|-------------------------------------|
| a. CrBr_2 | c. HgCl | e. $\text{HNO}_3(\text{aq})$ |
| b. Na_2S | d. PbI_2 | f. KOH |

Covalent

- Non-metal and non-metal
- Sharing of electrons
- No ions formed in the process
- Bond is shared electrons between the two atoms (2, 4 or 6 electrons)
- Difference in electronegativity less than 1.7



Covalent Bonds – involve a sharing of a pair of valence electrons between atoms.



2 Types of Covalent Bonds

Polar Covalent

Non-polar covalent

Unequal sharing
of electrons

Equal sharing
of electrons

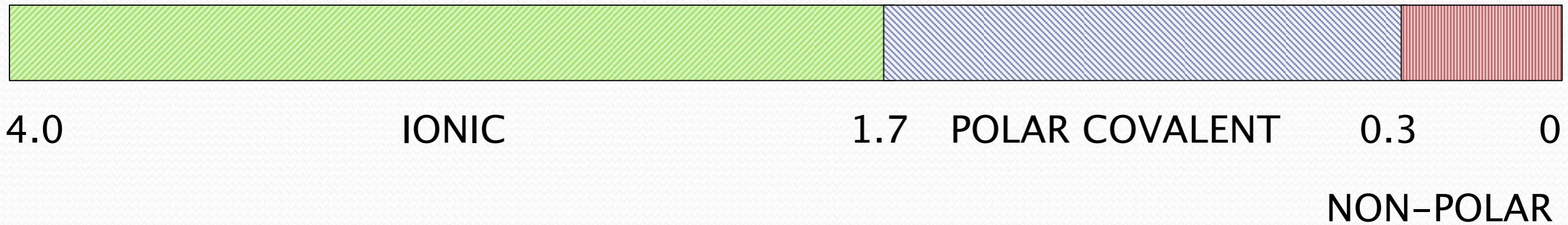
E.g., H₂O

Determined by the atoms

**E.g., H₂
O₂**

ELECTRONEGATIVITY

Covalent vs. Polar covalent



- Between 0.0 - 0.3 **non-polar covalent bond** - bonding electrons are shared equally (H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂) - they form a “7” on the table.
- between 0.3 - 1.7 **polar covalent bond** - the more electronegative atom attracts the shared electron pair more strongly than the less electronegative atom (ex: HCl)

The boy is **not equally** sharing with anyone else but rather taking all the food for himself.



Polar Covalent

Non-polar covalent



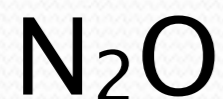
The children are **equally** sharing the drink between themselves.

Naming Molecular Compounds

Rules for Naming Binary Molecular Compounds

1. Name the element with the lower group number first. Name the element with the higher group number second.
2. The one exception to the first rule occurs when oxygen is combined with a halogen. In this situation, the halogen is named first.
3. If both elements are in the same group, name the element with the higher period number first.
4. The name of the first element is unchanged.
5. To name the second element, use the root name of the element and add the suffix *-ide*.
6. If there are two or more atoms of the first element, add a prefix to indicate the number of atoms.
7. Always add a prefix to the name of the second element to indicate the number of atoms of this element in the compound. (If the second element is oxygen, an “o” or “a” at the end of the prefix is usually omitted.)

Number	Prefix
1	mono-
2	di-
3	tri-
4	tetra-
5	penta-
6	hexa-
7	hepta-
8	octa-
9	nona-
10	deca-



Dinitrogen monoxide

Phosphorous pentachloride

Dichloride heptaoxide

Try it!

1. Write the name of P_4S_7 .
2. Write the name of $Pb(NO_3)_2$.
3. Write the formula for manganese(IV) chloride.
4. Write the formula for nitrogen triiodide.
5. Write the name of $CuBr$.
6. Write the formula for iron(III) oxide.
7. Write the formula for silicon dioxide.
8. Write the name of SeF_6 .
9. Write the name of CaO .
10. Write the formula for cobalt(III) nitrate.