Office Hours: M 1:30pm – 3:00pm
(in Park 169) W 11:00am – 12:00pm
or by appointment (email me)
or just email me with questions!

TA Hours w/ Dana: Th 6:00pm – 7:00pm
(in Park 273) F 4:30pm – 6:00pm

Q-center: https://www.brynmawr.edu/inside/offices-services/q-center/q-center-schedule

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Isotopes

Naming Compounds (Nomenclature Rules)

9/11/2026

Achieve HW #2 due Monday 9/14 at 10:00am
Achieve HW #3 due Thursday 9/17 at 8:00pm

Exam 1 in lecture a week from today! (everything through naming)
Quiz #1 in Recitation today (9/11) – all material up through unit conversions

Chemistry ice cream social

Today @ 4pm in Park atrium courtyard

Learning Objectives

- Define isotopes and give examples for several elements

- Write and interpret symbols that depict the atomic number, mass number, and charge of an atom or ion
- Define the atomic mass unit and average atomic mass
- Calculate average atomic mass and isotopic abundance

- Define ionic and molecular (covalent) compounds
- Predict the type of compound formed from elements based on their location within the periodic table

- Determine formulas for simple ionic compounds
- Derive names for common types of inorganic compounds using a systematic approach

- Know the polyatomic ion names, charges, and formulas indicated in the table on slide 16, and how to use them in nomenclature

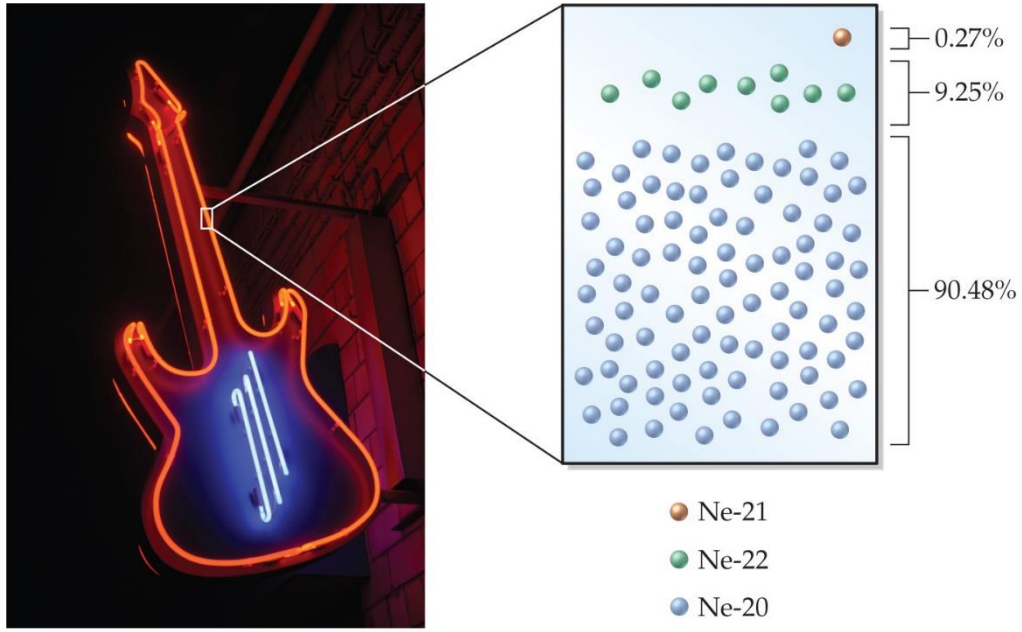
Isotopes: When the Number of Neutrons Varies

- All atoms of a given element have the same number of protons.
- They do not necessarily have the same number of neutrons.
- Atoms with the same number of protons but different numbers of neutrons are called **isotopes**.
- All elements have their own unique percent **natural abundance** of isotopes.

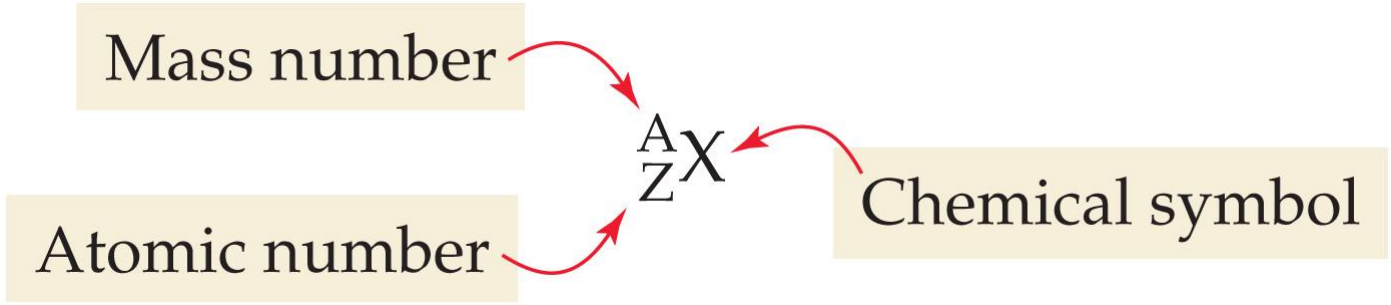
Isotopes: Natural Abundance of Isotopes in Neon

Naturally occurring neon contains three different isotopes:

	# protons	# neutrons	Mass Number (A)	Percent Abundance
Ne-20	10	10	20	90.48%
Ne-21	10	11	21	0.27%
Ne-22	10	12	22	9.25%



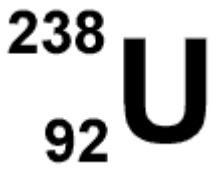
Isotope Symbol Notation



Isotopes of Neon: $^{20}_{10}Ne$ $^{21}_{10}Ne$ $^{22}_{10}Ne$

Mass number (A) = # protons + # neutrons

How many protons and neutrons are in this isotope of Uranium?

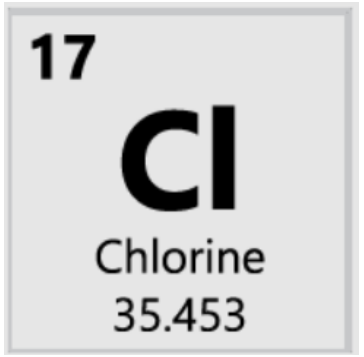


If an atom has a mass number of 32 and has 17 neutrons, it is an isotope of which element?

What is unique for each element?

What are the atomic number, mass number, and symbols for the chlorine isotope with 18 neutrons?

Atomic Mass



Atomic mass: mass of element listed in periodic table

Atomic mass on periodic table is a _____ _____

based on the natural abundance of each **isotope!**

	# protons	# neutrons	Mass Number (A)	Mass (amu)	Percent Abundance
Cl-35	17	18	35	34.97 amu	75.77%
Cl-37	17	20	37	36.97 amu	24.23%

Atomic mass = (75.77% x 34.97 amu) + (24.23% x 36.97 amu)

= (0.7577 x 34.97 amu) + (0.2423 x 36.97 amu) = 35.45 amu

Calculate the atomic mass of magnesium:

- isotope 1: 23.99 amu, 78.99% abundance
- isotope 2: 24.99 amu, 10.00% abundance
- isotope 3: 25.98 amu, 11.01% abundance

Molecules & Compounds

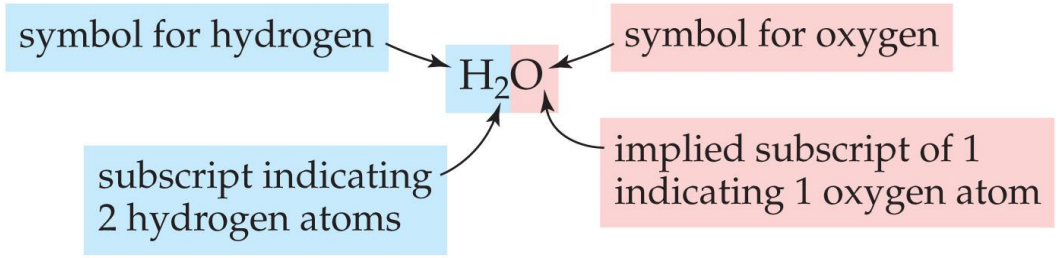
Molecule: two or more atoms held together by chemical bonds (ex: O_2, H_2O)

Compound: Pure substance consisting of two or more different elements combined in whole-number ratios (ex: H_2O)

Chemical Formulas

Indicate the ratio of each element in the compound

Ratio is always the same for a given compound



Example: H_2O

H = symbol for hydrogen; subscript 2 means 2 H atoms

O = symbol for oxygen; implied subscript 1 means 1 O atom

Table Sugar: $C_{12}H_{22}O_{11}$

12 C atoms, 22 H atoms, 11 O atoms in every molecule

Ratio 12:22:11

Chemical Formulas

- Metal elements are listed first (example NaCl, KBr)

- For nonmetals, list the most metallic element first (left-most in periodic table) (Example: CO_2, NO)

Example: Write a chemical formula for a compound containing two silver atoms for every sulfur atom.

Polyatomic Ions

Charged species (ion) made up of two or more atoms

Example: Nitrate ion = NO^-_3

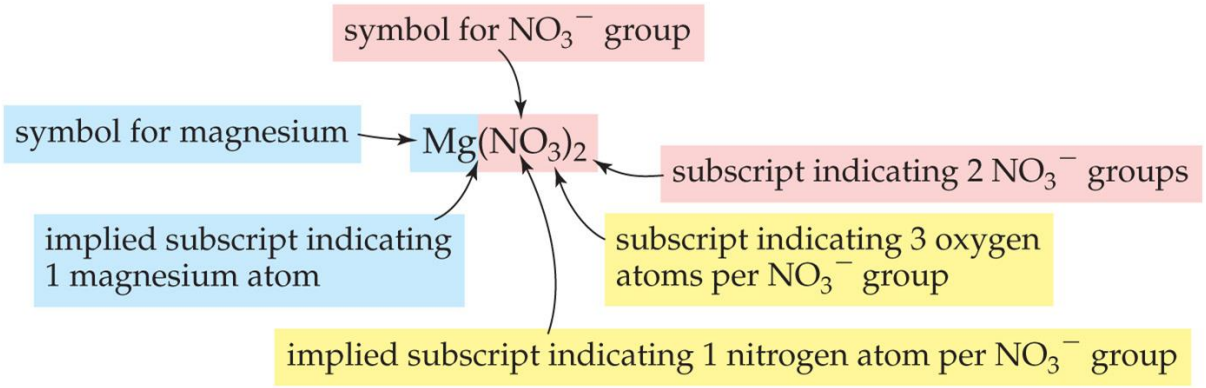
Magnesium Nitrate $Mg(NO_3)_2$

___ nitrate ions for every ___ magnesium

___ Mg and ___ NO^-_3

in total: __ Mg, __ N, ___ O

Polyatomic Ions



Memorize these names, formulas, and charges!

Flash cards!

Polyatomic Ion	Name	Polyatomic Ion	Name
NO_3^-	Nitrate	ClO_4^-	Perchlorate
NO_2^-	Nitrite	ClO_3^-	Chlorate
SO_4^{2-}	Sulfate	ClO_2^-	Chlorite
SO_3^{2-}	Sulfite	ClO^-	Hypochlorite
PO_4^{3-}	Phosphate	*Pattern above applies to other halogens as well (i.e. bromate, iodite)	
CO_3^{2-}	Carbonate	CN^-	Cyanide
HCO_3^-	Bicarbonate	OH^-	Hydroxide
$C_2H_3O_2^-$	Acetate	NH_4^+	Ammonium
MnO_4^-	Permanganate		

Example:

Determine the number of each type of atom in $Al_2(SO_4)_3$

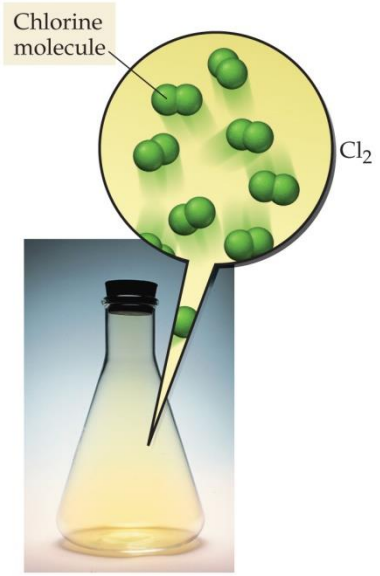
Elements and Compounds

Elements = cannot be simplified

Compounds = composed of two or more elements

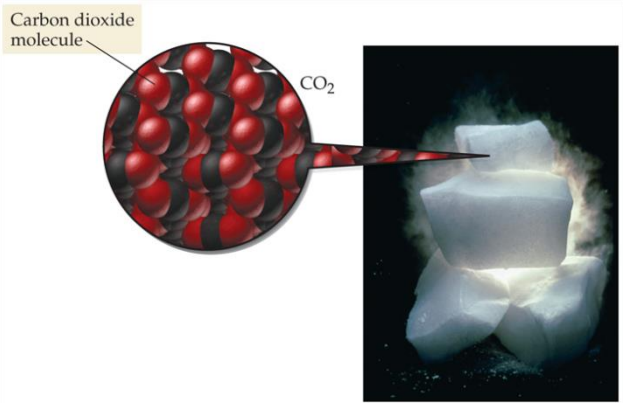
Atomic Elements: Exist as single atoms; Most elements; Example: Helium, Copper, Carbon

Molecular Elements ("Diatomic Elements"): Exist as two atoms bonded together; There are seven: H_2, O_2, N_2, Cl_2, F_2, I_2, Br_2



Covalent Compounds (also called molecular compounds):

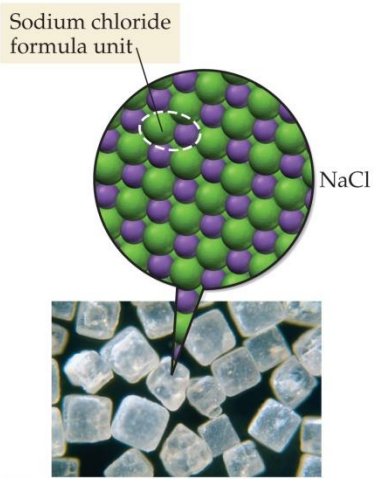
two or more nonmetals (example: H_2O, CO_2, many organic molecules are made of C H and O)



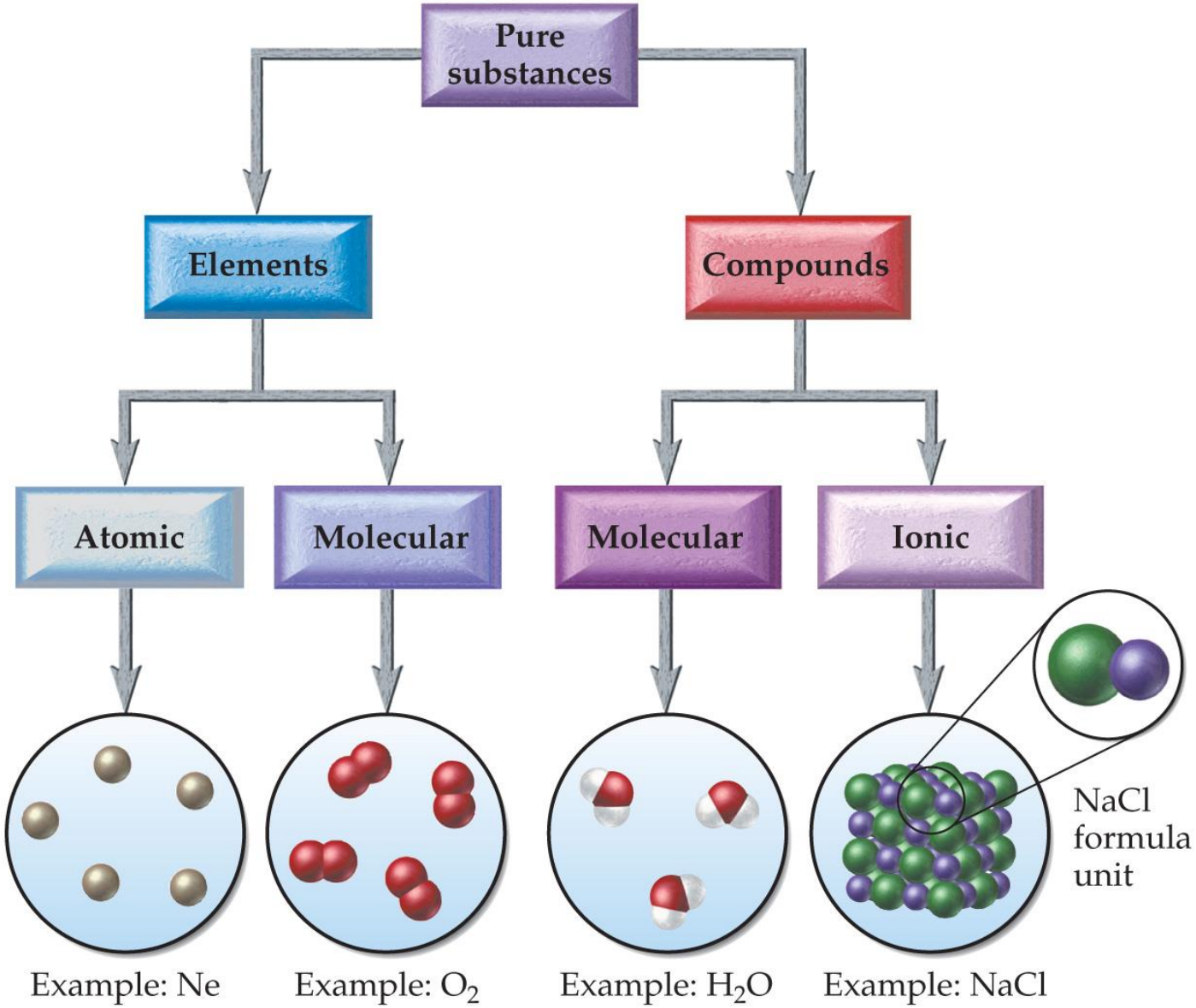
Ionic Compounds: formed from a metal and a nonmetal

Not a real "bond" between ions: just + and – attraction.

metals have positive charge (lose electrons),
nonmetals have negative charge (gain electrons)



Classification of Elements and Compounds



Practice: Classify each element (as atomic or diatomic/molecular) or compound (as covalent/molecular or ionic).

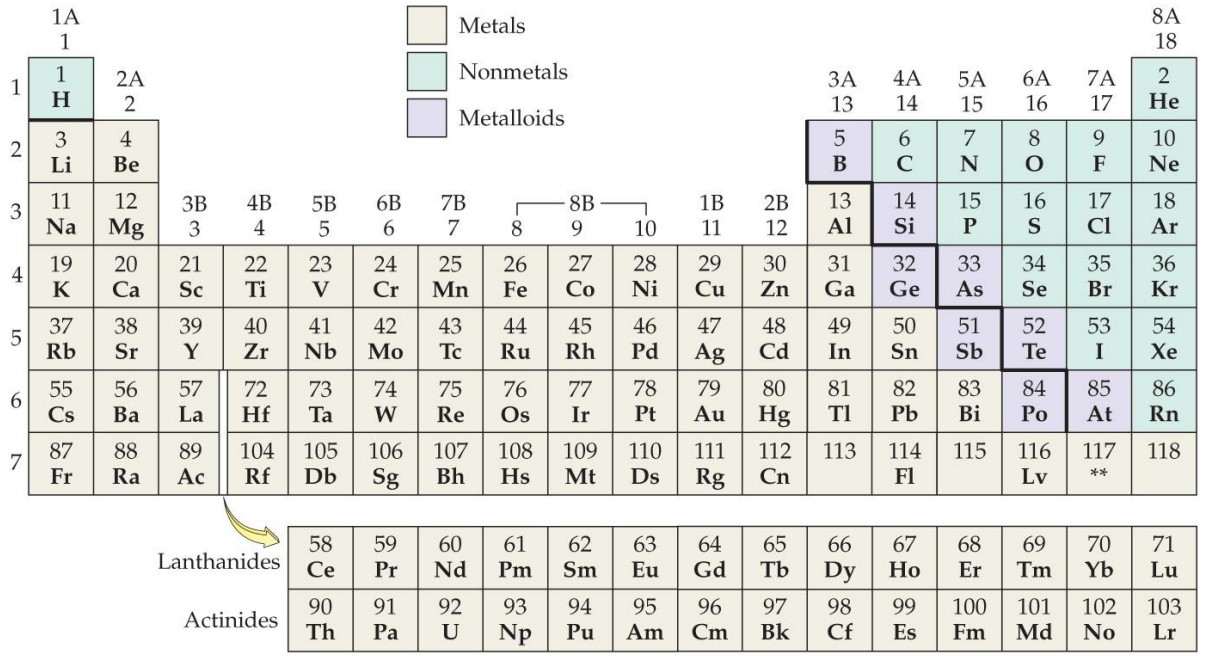
(a) Chlorine

(b) NO

(c) gold (Au)

(d) Na_2O

(e) $CrCl_3$



Writing Formulas for Ionic Compounds

Ionic compounds are neutral (charges cancel out)

Formulas can be predicted based on periodic table (charge rules)

Example: Na_xCl_y

Mg and Cl

Aluminum and Oxygen:

Writing formula with polyatomic ions

- Ionic compounds often contain one or more polyatomic ions
  - Polyatomic ion: charged species (ion) made up of two or more atoms

Example: $Mg(NO_3)_2$

2 goes outside the parenthesis to indicate there are 2 NO_3^- ions.

K and CO_3^{2-}

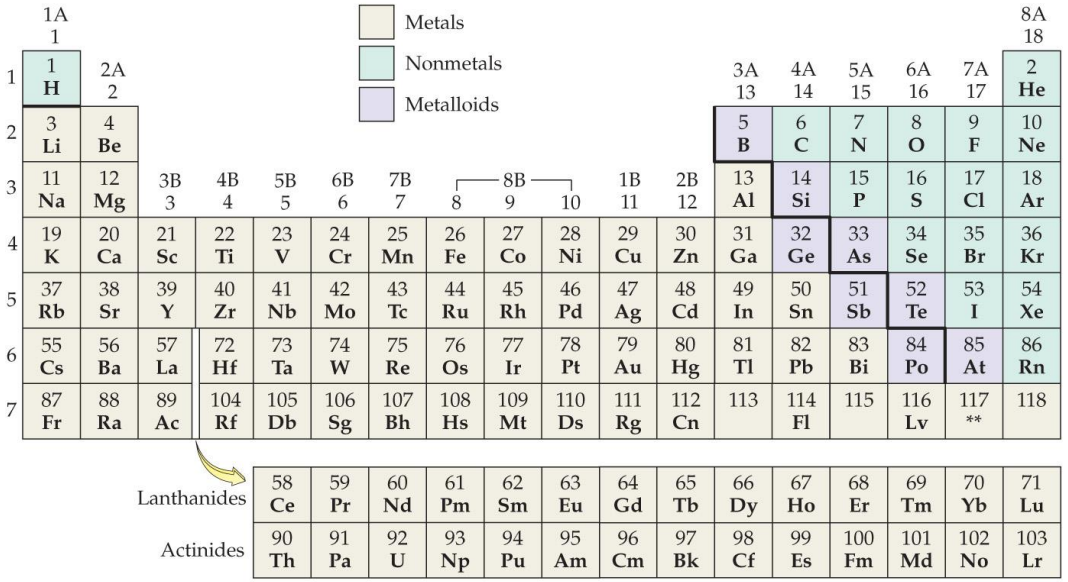
Al and SO_4^{2-}

Mg and O

Na and hydroxide

Nomenclature: Naming Ionic Compounds

- The first step in naming an ionic compound is **identifying** it as one.
  - If there is a **metal** and a **nonmetal** together in a chemical formula, the compound is ionic.
  - Covalent compounds (made of nonmetals only) use *different* naming rules.



Naming Cations in Ionic Compounds

Type 1 Metal: only forms one type of ion

ex: Na only forms 1+ ion (Na^+)

Group 1A, 2A, 3A

Zinc = Zn^{2+} and Silver = Ag^+

Type 2 Metal: can form more than one type of ion

ex: Fe forms Fe^{2+} and Fe^{3+}

Most transition metals form more than one type of ion

Type II Metal	Charges
Cr	2+, 3+
Fe	2+, 3+
Co	2+, 3+
Cu	1+, 2+
Sn	2+, 4+
Pb	2+, 4+
Hg_2^{2+} / Hg^{2+}	1+, 2+

For naming:

Type 1 cation - name is just name of element

ex: Na^+ =

Type 2 cation - name includes the charge as a roman numeral

ex: Fe^{2+} =

Fe^{3+} =

If the cation is a polyatomic ion, just use its name
ex. NH_4^+ = ammonium

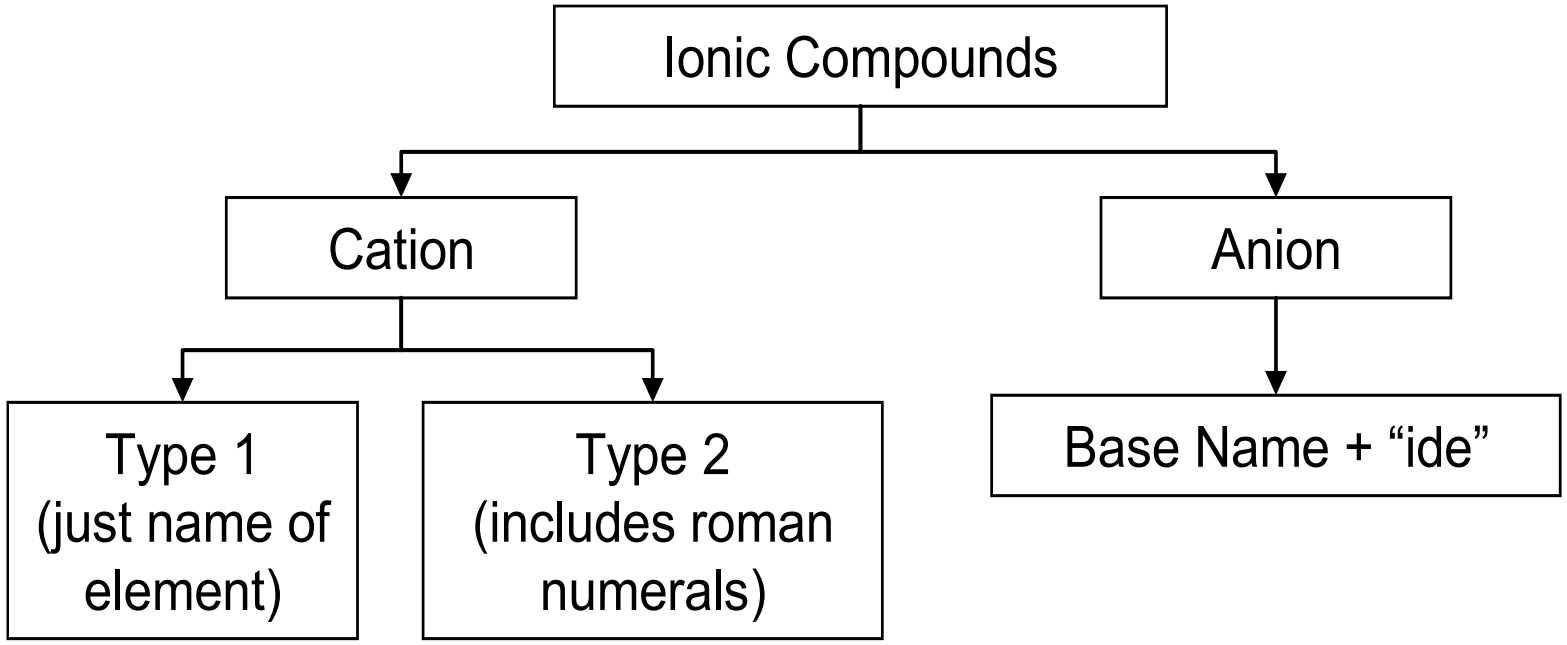
Naming Anions in Ionic Compounds

Drop ending of nonmetal's name and change it to –ide

Nonmetal	Symbol	Base Name	Anion Name
fluorine	F^-	fluor-	fluoride
chlorine	Cl^-	chlor-	chloride
bromine	Br^-	brom-	bromide
iodine	I^-	iod-	iodide
oxygen	O^{2-}	ox-	oxide
sulfur	S^{2-}	sulf-	sulfide
nitrogen	N^{3-}	nitr-	nitride

If the anion is a polyatomic ion, just use its name.

Naming Ionic Compounds



$NaCl$

$FeCl_3$

KBr

$PbCl_4$

Zn_3N_2

PbO

$Cu(NO_2)_2$

$Fe(OH)_2$

KNO_3

$NaClO$

$NaHCO_3$

Naming Molecular/Covalent Compounds

Molecular (covalent) compounds – two nonmetals

- Use prefixes

mono = 1	penta = 5
di = 2	hexa = 6
tri = 3	hepta = 7
tetra = 4	octa = 8

- Mono is omitted for the first element (but used for the second element)

CO_2

CCl_4

NO

SF_6

N_2O

N_2O_4

- Achieve HW has very thorough practice with naming!

- Most difficult part? When given a mixture of ionic/covalent compounds….

  - **First** have to decide **which naming scheme to use???**

  - Does the compound have **nonmetals only**? (covalent compound)
    - Use prefixes (di, tri, tetra, etc)

  - Does the compound have a **metal** + a nonmetal? (ionic compound)
    - **No prefixes (di, tri, etc) in name**!
    - Is the metal in a column that follows charge rules?
      - If Yes – name is simple
      - If No – must find charge on metal and list as roman numeral!