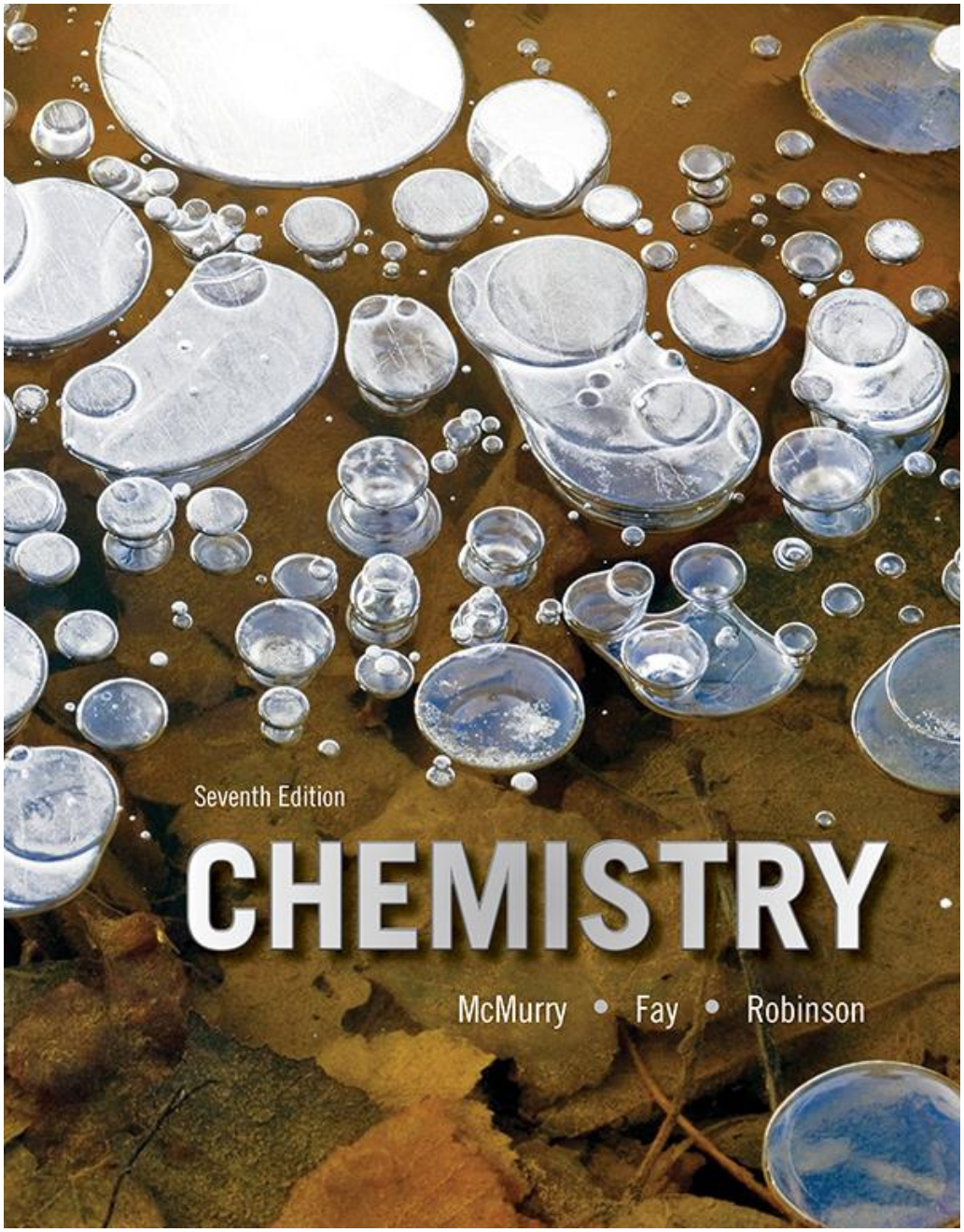


Lecture Presentation

Chapter 2
Atoms, Molecules, and Ions

HW: 2.2, 2.3, 2.4, 2.5, 2.7, 2.8, 2.11, 2.13, 2.16, 2.17, 2.19, 2.21, 2.23, 2.24, 2.31, 2.40, 2.46, 2.48, 2.52, 2.60, 2.76?, 2.78?, 2.92, 2.96, 2.98, 2.112, 2.114, 2.124, 2.132, 2.138, 2.142, 2.144, 2.146

John E. McMurry
Robert C. Fay

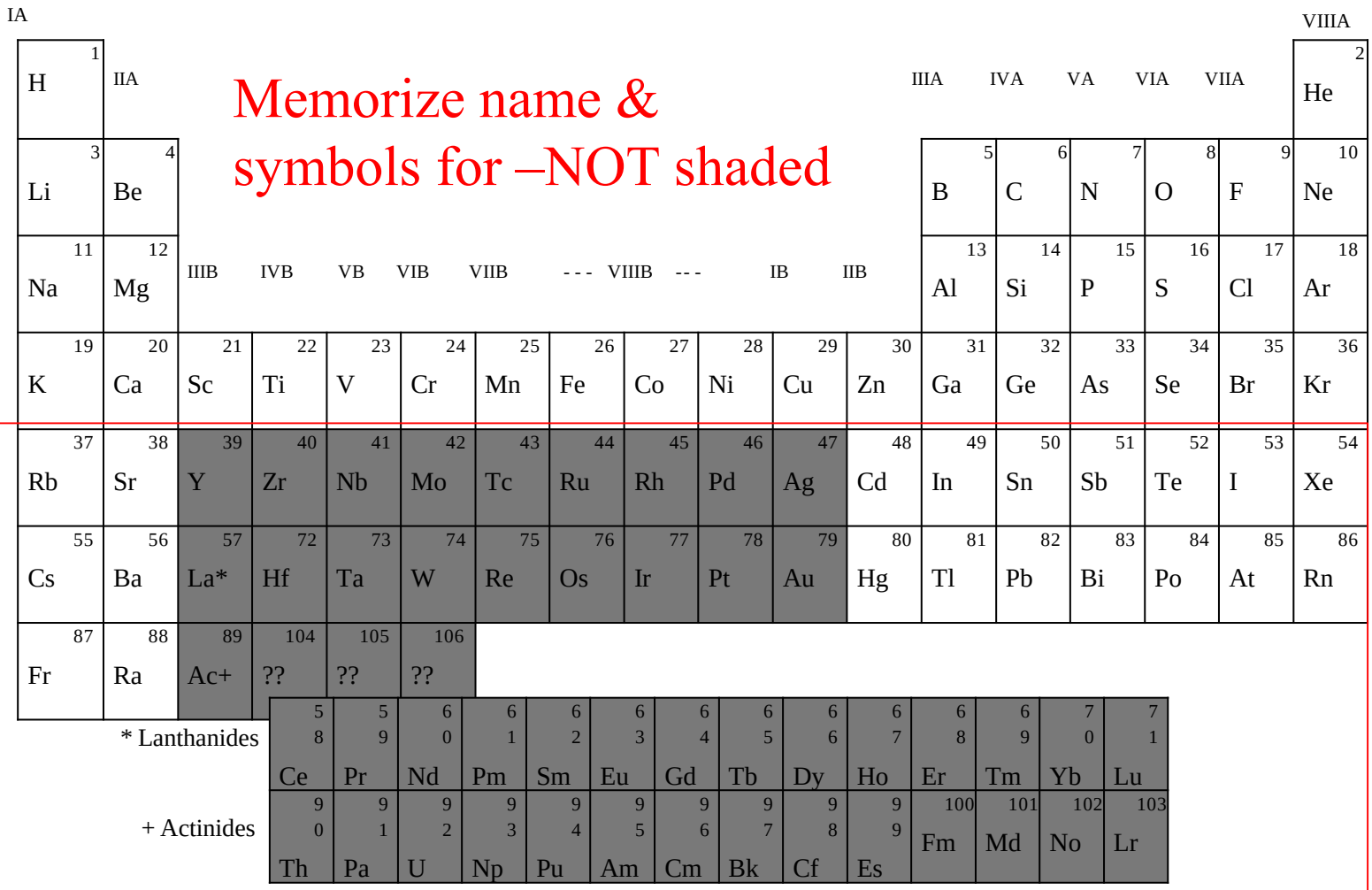
Instructor's Resource Materials (Download only) for *Chemistry,* 7e
John E. McMurry, Robert C. Fay, Jill Robinson

Chemistry and the Elements

TABLE 2.1 Names and Symbols of Some Common Elements. Latin names from which the symbols of some elements are derived are shown in parentheses.

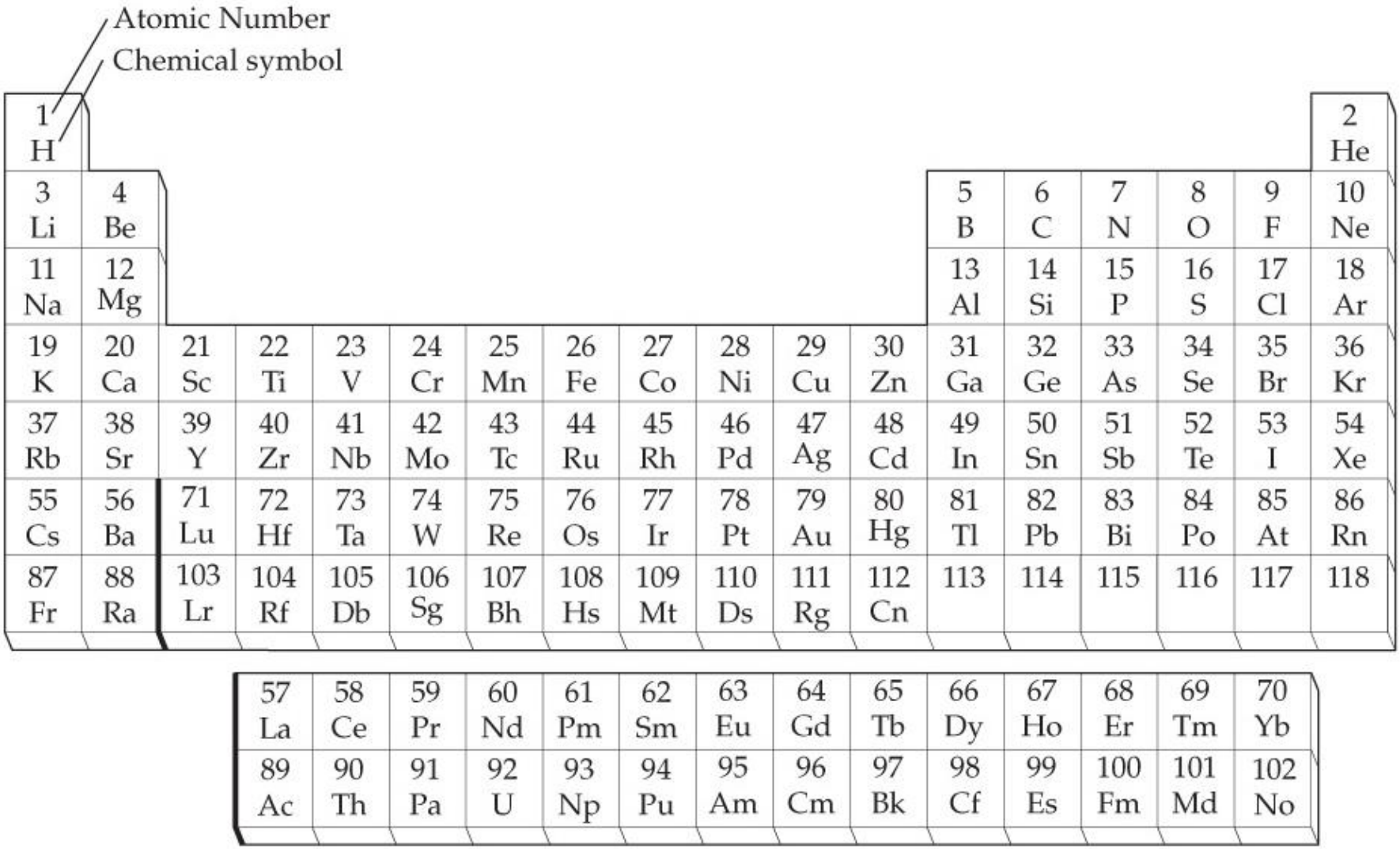
Aluminum	**Al**	Chlorine	**Cl**	Manganese	**Mn**	Copper (*cuprum*)	**Cu**
Argon	**Ar**	Fluorine	**F**	Nitrogen	**N**	Iron (*ferrum*)	**Fe**
Barium	**Ba**	Helium	**He**	Oxygen	**O**	Lead (*plumbum*)	**Pb**
Boron	**B**	Hydrogen	**H**	Phosphorus	**P**	Mercury (*hydrargyrum*)	**Hg**
Bromine	**Br**	Iodine	**I**	Silicon	**Si**	Potassium (*kalium*)	**K**
Calcium	**Ca**	Lithium	**Li**	Sulfur	**S**	Silver (*argentum*)	**Ag**
Carbon	**C**	Magnesium	**Mg**	Zinc	**Zn**	Sodium (*natrium*)	**Na**

memorize name & symbols for following (next slide) table – most are obvious (C, N, O, S, Ca, etc)



Memorize name & symbols for –NOT shaded

Do not need to memorize for 1st quiz & test. Will put rest on later quizzes & exams



Elements and the Periodic Table

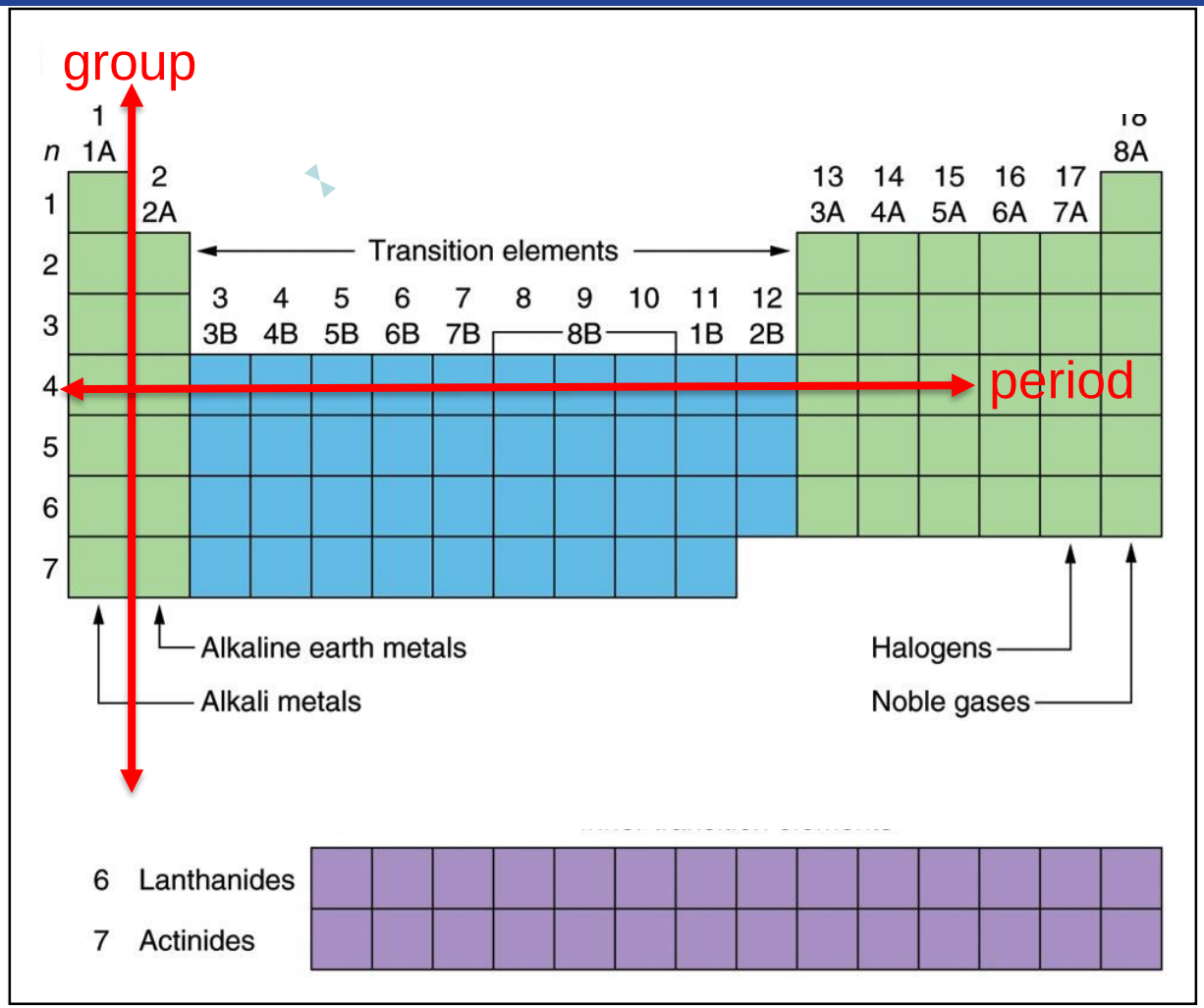
Periods: 7 horizontal rows

Groups: 18 vertical columns

- International standard: 1–18
- U.S. system: 1A–8A, 1B–8B

The Periodic Table – Divided into Periods and Groups

9/4 W
D end



Elements and the Periodic Table

Main Groups

- Columns 1A–2A (2 groups)
- Columns 3A–8A (6 groups)

Transition Metals: 3B–2B (8 groups, 10 columns)

Inner Transition Metals: 14 groups between 3B and 4B

- Lanthanides
- Actinides

F 9/4 W
end

Some Chemical Properties of the Elements

Intensive Properties: Independent of sample size

- Temperature
- Melting point
- Density

Extensive Properties: Dependent on sample size

- Length
- Volume

Some Chemical Properties of the Elements

Physical Properties: Characteristics that *do not* involve a change in a sample's chemical makeup

Chemical Properties: Characteristics that *do* involve a change in a sample's chemical makeup

TABLE 2.3 Some Examples of Physical and Chemical Properties

Physical Properties		Chemical Properties
Temperature	Amount	Rusting (of iron)
Color	Odor	Combustion (of gasoline)
Melting point	Solubility	Tarnishing (of silver)
Electrical conductivity	Hardness	Cooking (of an egg)

Physical and Chemical Changes

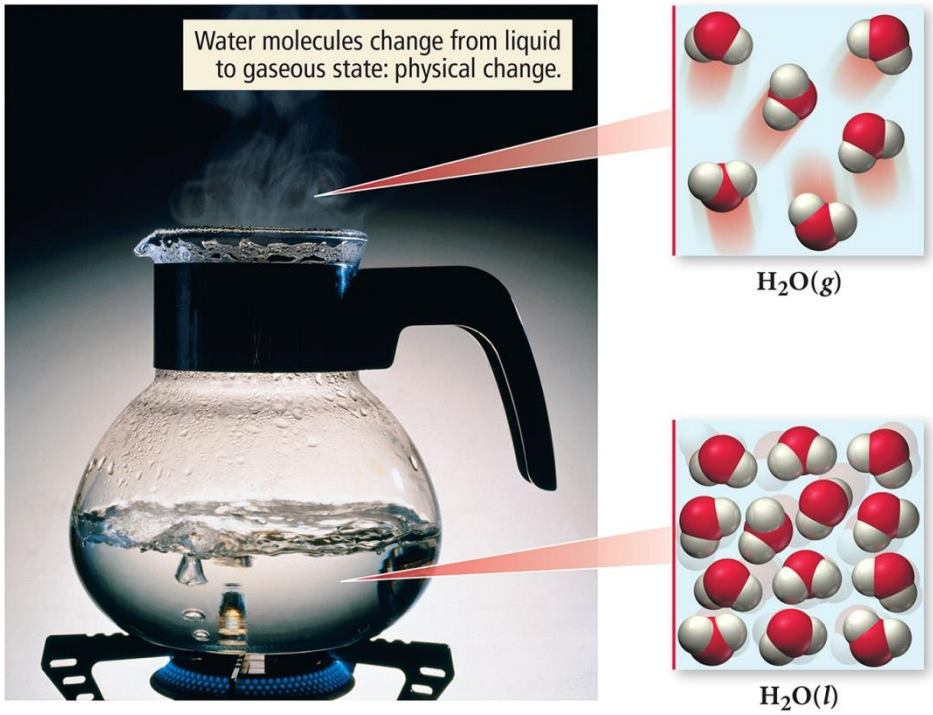
Physical Change:

- Changes that alter only the state or appearance of a substance, but not composition, are **physical changes**. (state = gas, liquid, solid)

- The atoms or molecules that compose a substance *do not change* their identity during a physical change. (no change in chemical composition)

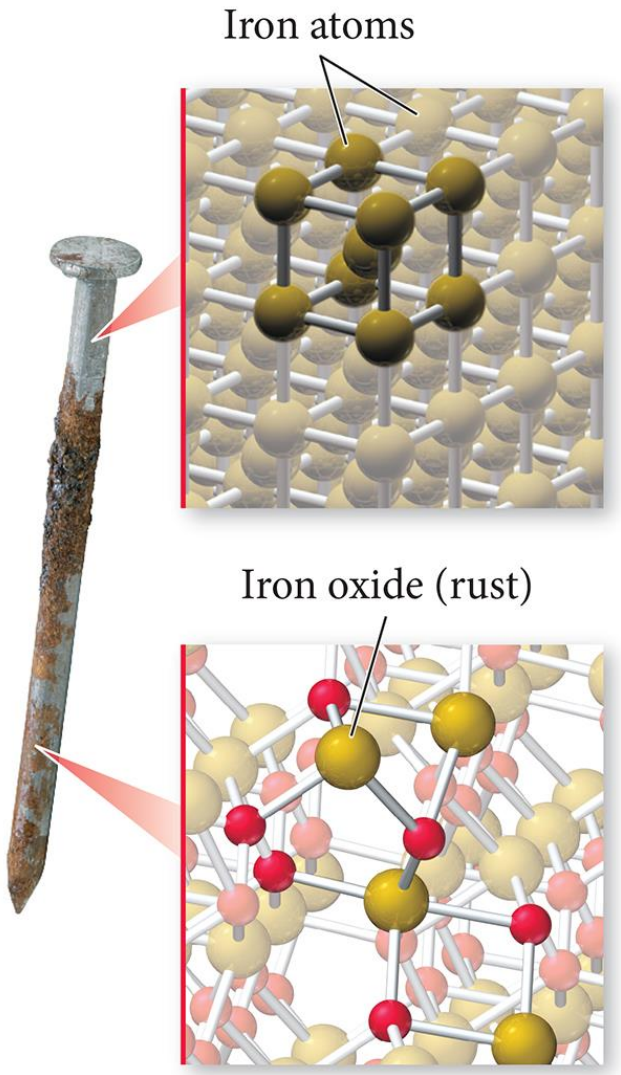
Physical Change

- When water boils, it changes its state from a liquid to a gas.
- The gas remains composed of water molecules, so this is a physical change.

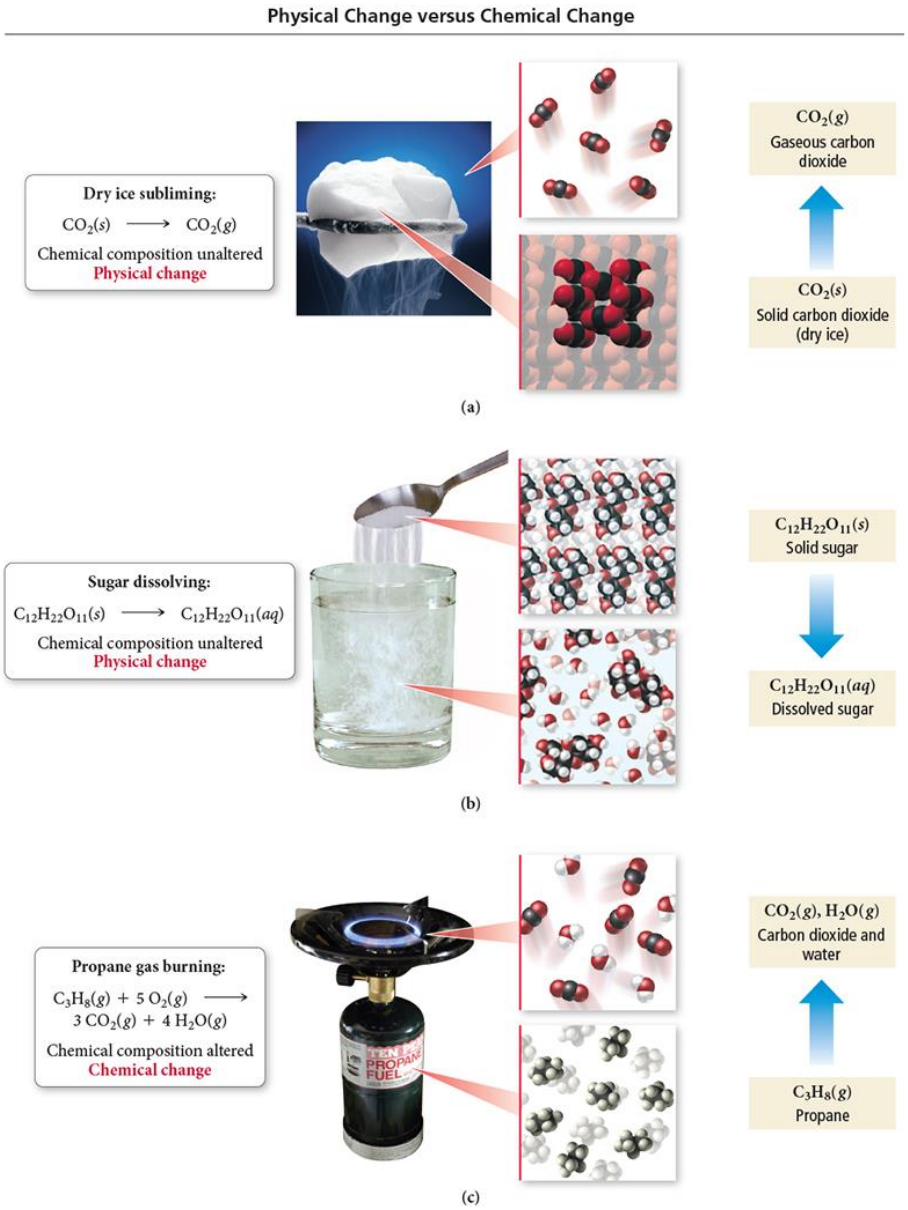


Chemical Change

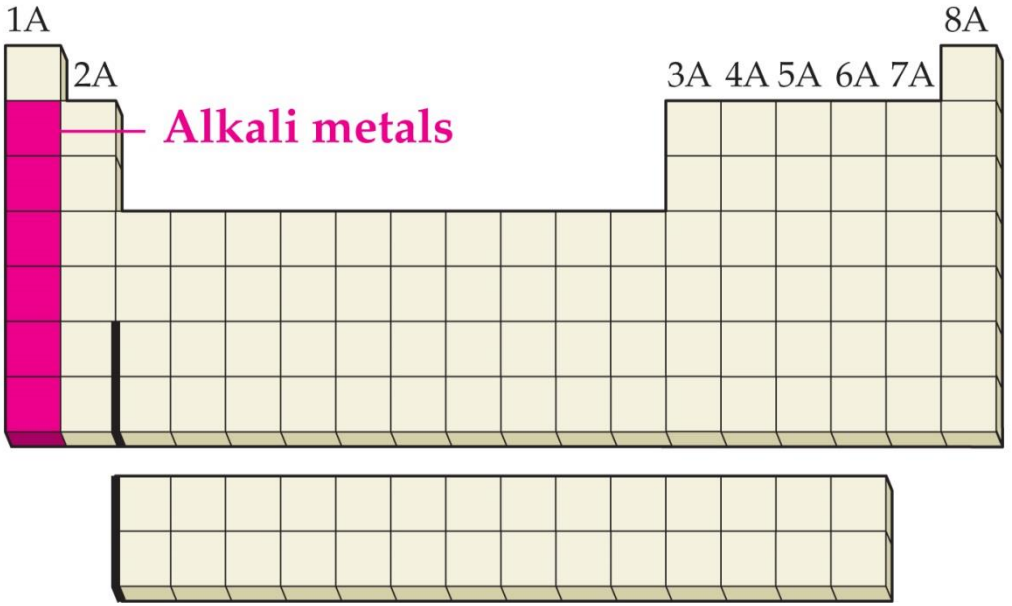
- Changes that alter the composition of matter are **chemical changes**.
- During a chemical change, atoms rearrange, transforming the original substances into different substances.
- Rusting of iron is a chemical change.



Physical and Chemical Changes

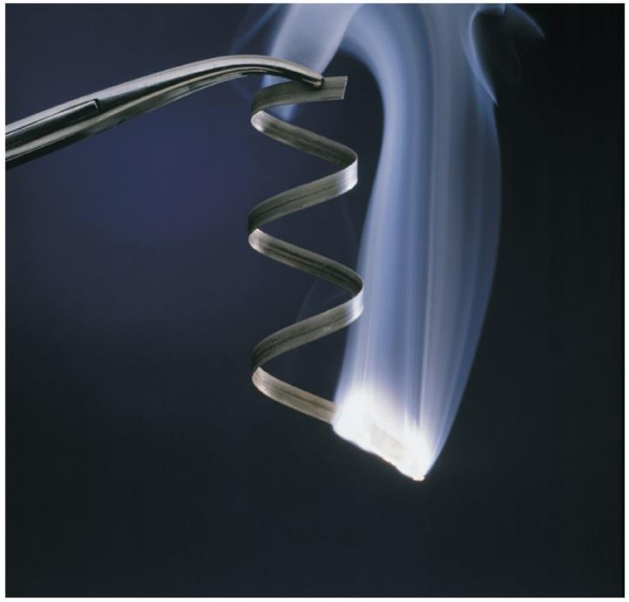


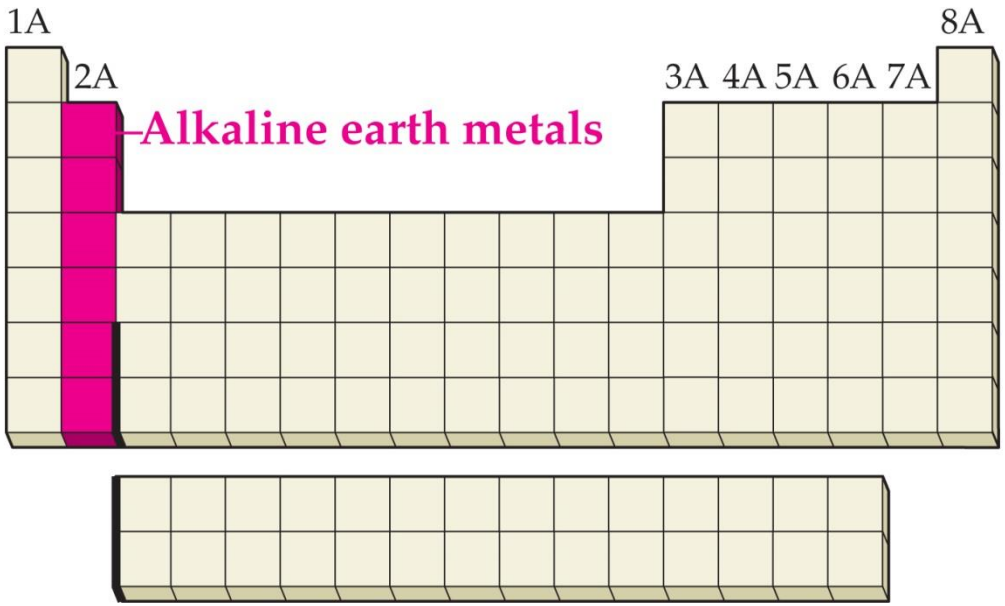
Some Chemical Properties of the Elements



silvery metal, very reactive with water - forms alkali (base) compounds

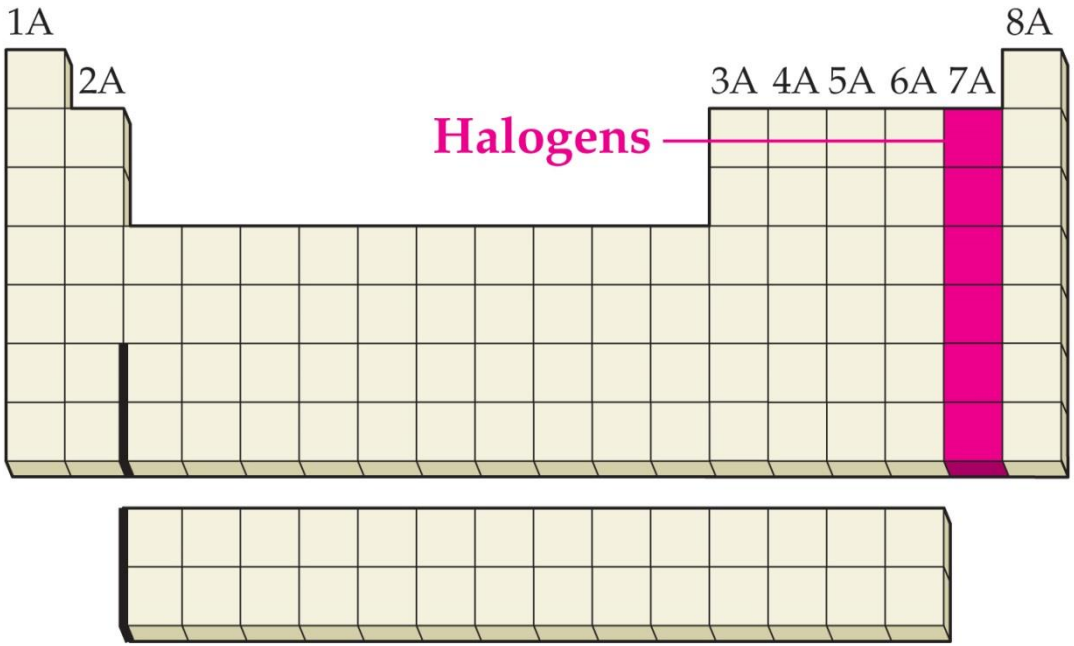
Some Chemical Properties of the Elements





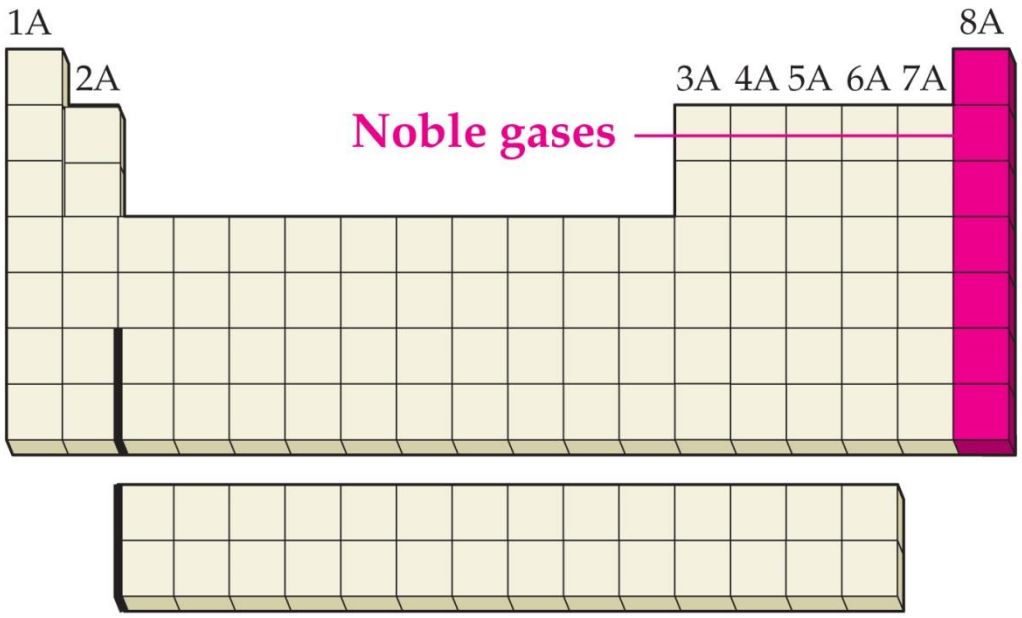
silvery metal, less reactive than alkali metals

Some Chemical Properties of the Elements



colorful corrosive nonmetals,
very reactive

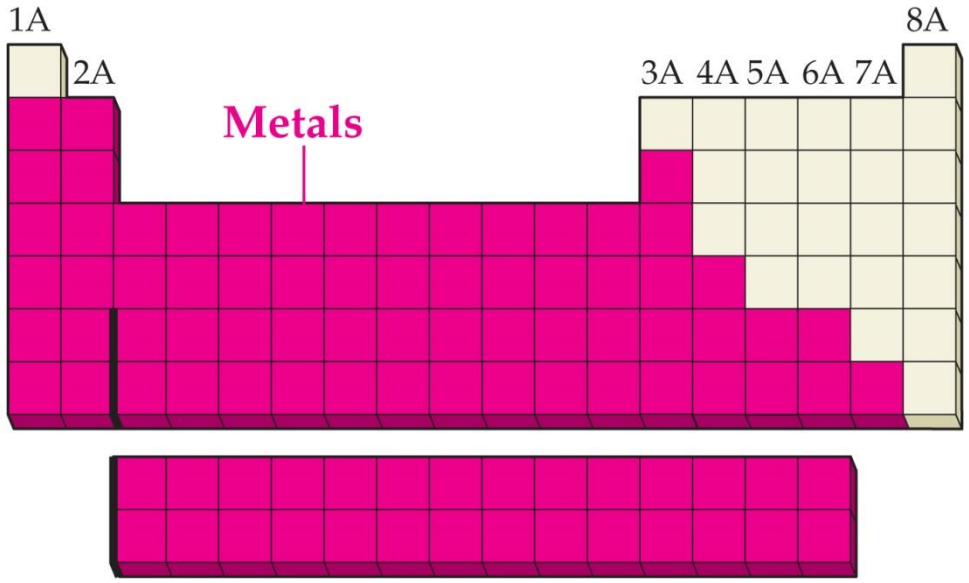
Some Chemical Properties of the Elements



colorless nonmetal, very unreactive

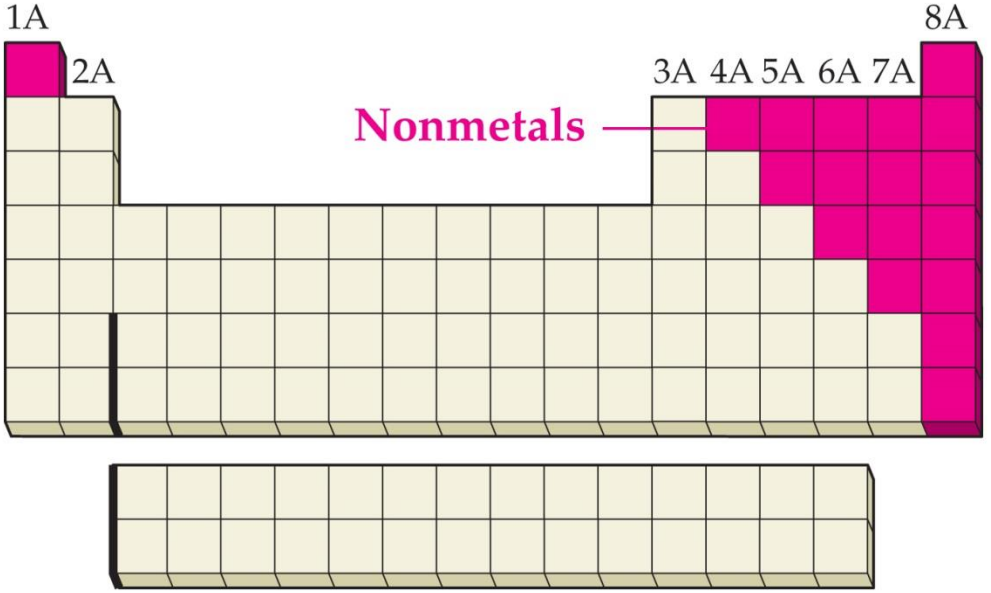
Some Chemical Properties of the Elements

Metals: Left side of the zigzag line in the periodic table (except for hydrogen) – usually solid, silvery, good conductor (heat, electricity), malleable



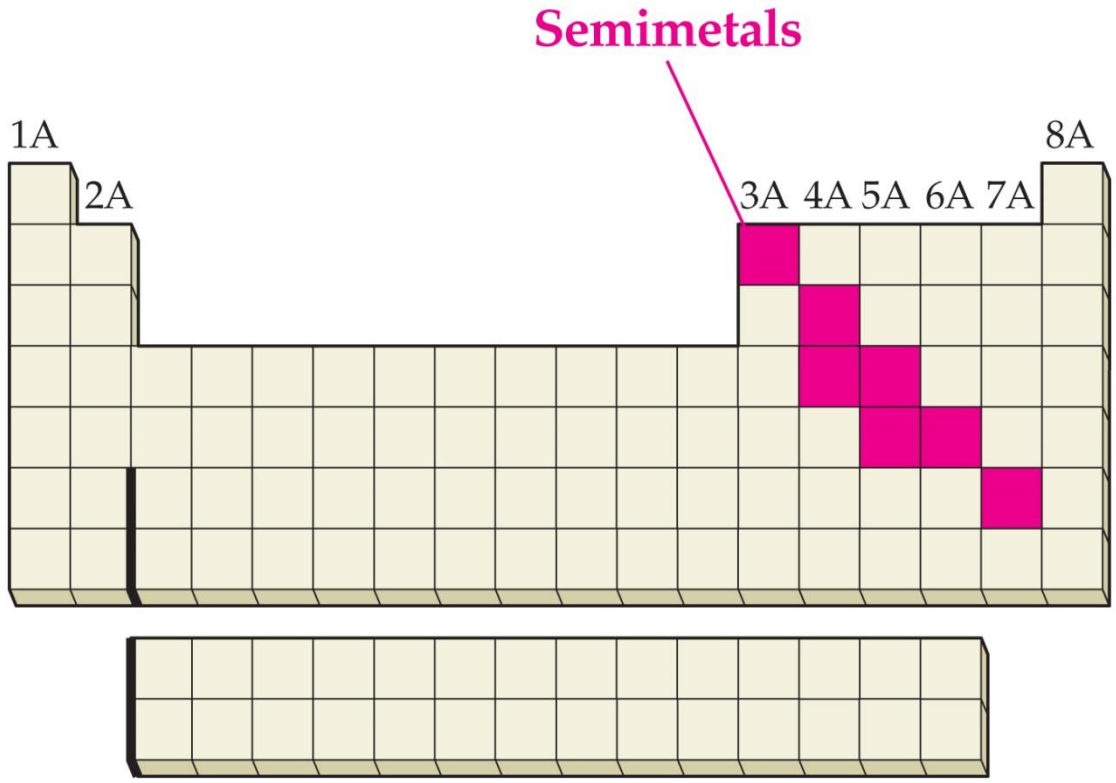
Some Chemical Properties of the Elements

Nonmetals: Right side of the zigzag line in the periodic table - mostly gases, brightly colored, brittle, bad conductor of heat & electricity



Some Chemical Properties of the Elements

Semimetals (metalloids): Tend to lie along the zigzag line in the periodic table – all are solid, most are silvery, brittle & not conductive



HW: circle & label the periodic table with (a) main group elements (b) transition metals (c) actinide/lanthanide (d) periods (e) groups (f) alkali metals (g) alkaline earth metals (h) halogens (i) metals (j) non metals (k) metalloids

End G sect 9/4, end 9/5D

1A	2A	3B	4B	5B	6B	7B	8B	1B	2B	3A	4A	5A	6A	7A	8A
1 H 1.008															2 He 4.003
3 Li 6.94	4 Be 9.01									5 B 10.81	6 C 12.011	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31									13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71	29 Cu 63.55	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98.91	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30
55 Cs 132.91	56 Ba 137.34	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.03	89 Ac (227)	104 Unq* (261)	105 Unp* (262)	106 Unh* (263)	107 Uns* (262)	108 Uno* (265)	109 Una* (266)									

Lanthanides	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
Actinides	90 Th 232.04	91 Pa (231)	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (249)	98 Cf (249)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

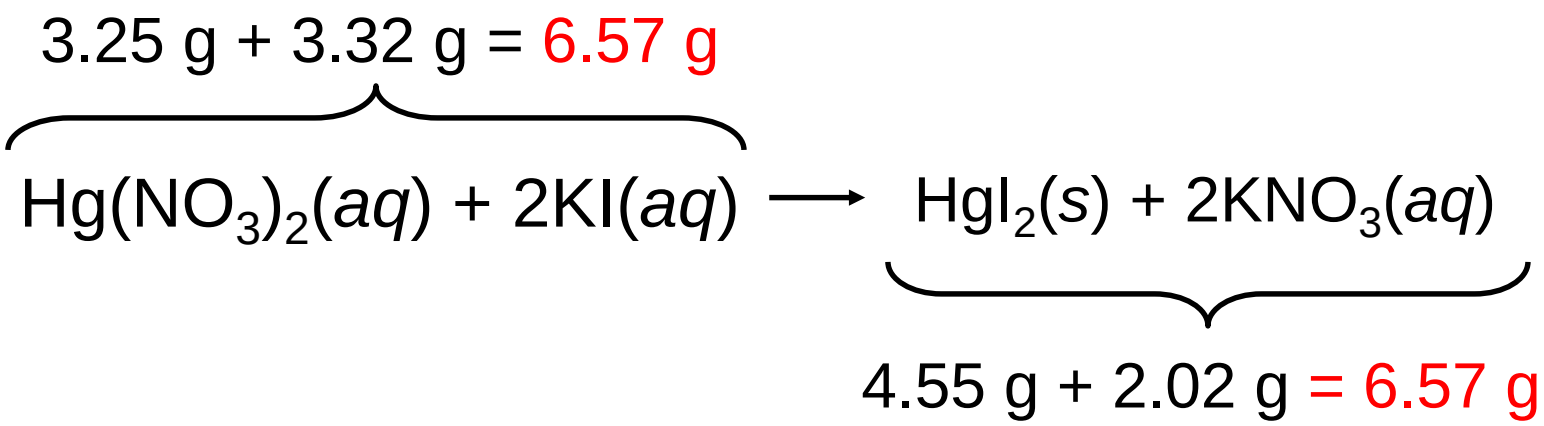
*Symbol (and name) provisional.

Numbers in parentheses: available radioactive isotope of longest half-life.

Conservation of Mass and the Law of Definite Proportions

Law of Conservation of Mass: Mass is neither created nor destroyed in chemical reactions.

Aqueous solutions of mercury(II) nitrate and potassium iodide will react to form a precipitate of mercury(II) iodide and aqueous potassium iodide.



Conservation of Mass and the Law of Definite Proportions

Known amounts of solid KI and solid $Hg(NO_3)_2$ are weighed and then dissolved in water.

The solutions are mixed to give **solid HgI_2**, which is removed by filtration.

The solution that remains is evaporated to give solid KNO_3. On weighing, the combined masses of the products equal the combined masses of the reactants.

$$3.25\ g + 3.32\ g = 6.57\ g$$

$$Hg(NO_3)_2(aq) + 2KI(aq) \longrightarrow HgI_2(s) + 2KNO_3(aq)$$

$$4.55\ g + 2.02\ g = 6.57\ g$$

Conservation of Mass and the Law of Definite Proportions

Law of Definite Proportions: Different samples of a pure chemical substance always contain the same proportion of elements by mass.

By mass, water is

88.8% oxygen
11.2% hydrogen

The Law of Multiple Proportions and Dalton's Atomic Theory

Law of Multiple Proportions: Elements can combine in different ways to form different substances, whose mass ratios are small whole-number multiples of each other.

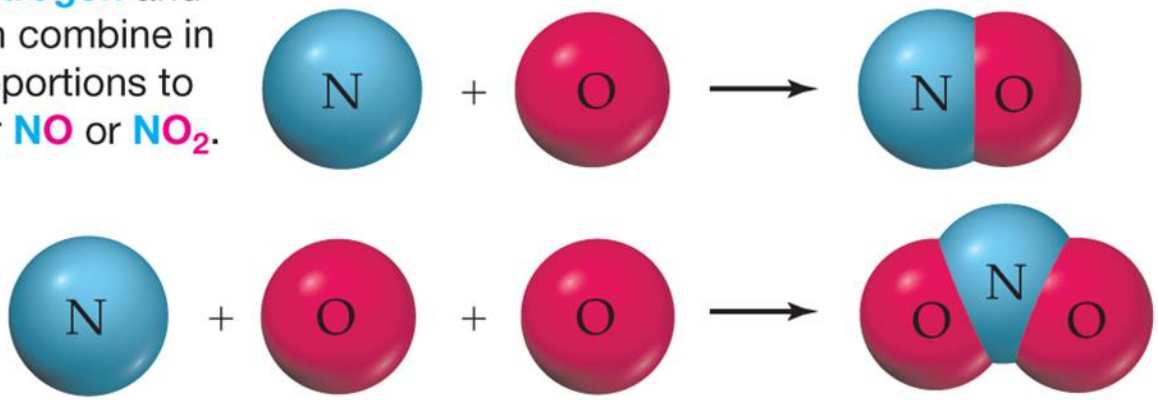
Nitrogen monoxide: 7 grams nitrogen per 8 grams oxygen (NO)

Nitrogen dioxide: 7 grams nitrogen per 16 grams oxygen (NO_2)

The Law of Multiple Proportions and Dalton's Atomic Theory

Law of Multiple Proportions: Elements can combine in different ways to form different substances, whose mass ratios are small whole-number multiples of each other. (bc combining discrete atoms not something like sugar and sand)

Atoms of **nitrogen** and **oxygen** can combine in specific proportions to make either **NO** or NO_2.



NO_2 contains exactly twice as many atoms of **oxygen** per atom of **nitrogen** as **NO** does.

The Law of Multiple Proportions and Dalton's Atomic Theory

- Elements are made up of tiny particles called **atoms**.

- Each **element** is characterized by the **mass of its atoms**. Atoms of the same element have the same mass, but atoms of different elements have different masses.

The Law of Multiple Proportions and Dalton's Atomic Theory

- The chemical combination of elements to make different chemical compounds occurs when atoms join in small whole-number ratios. (NO vs NO_2) (H_2O_2 vs H_2O) (bc not fractions of atoms & atomic mass of element does not change) F sect 9/6 Friday

- Chemical reactions only rearrange how atoms are combined in chemical compounds; the atoms themselves don't change.

Atomic Structure: Protons and Neutrons

TABLE 2.4 A Comparison of Subatomic Particles

Particle	Mass		Charge	
	Grams	u*	Coulombs	*e*
Electron	$9.109\,382 \times 10^{-28}$	$5.485\,799 \times 10^{-4}$	$-1.602\,176 \times 10^{-19}$	−1
Proton	$1.672\,622 \times 10^{-24}$	1.007 276	$+1.602\,176 \times 10^{-19}$	+1
Neutron	$1.674\,927 \times 10^{-24}$	1.008 665	0	0

*The unified atomic mass unit (u) is defined in Section 2.9.

The mass of the atom is primarily in the nucleus.

Atomic Structure: Protons and Neutrons

TABLE 2.4 A Comparison of Subatomic Particles

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Proton	$1.672\,622 \times 10^{-24}$	1.007 276	$+1.602\,176 \times 10^{-19}$	+1
Neutron	$1.674\,927 \times 10^{-24}$	1.008 665	0	0

*The unified atomic mass unit (u) is defined in Section 2.9.

Charge of a Proton is the same size but opposite in sign to the charge of an electron.

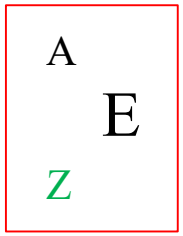
Atomic Numbers

Atomic Number (*Z*): Number of protons in an atom's nucleus, equivalent to the number of electrons around an atom's nucleus

Mass Number (*A*): The sum of the number of protons and the number of neutrons in an atom's nucleus

Isotope: Atoms with identical atomic numbers but different mass numbers (same # proton, different # neutrons)

Atomic Numbers



Element symbol
(not periodic table)

Carbon-12:

Mass number

$^{12}_{6}C$

Atomic number

6 protons
6 electrons
6 neutrons

isotopes

Carbon-14:

Mass number

$^{14}_{6}C$

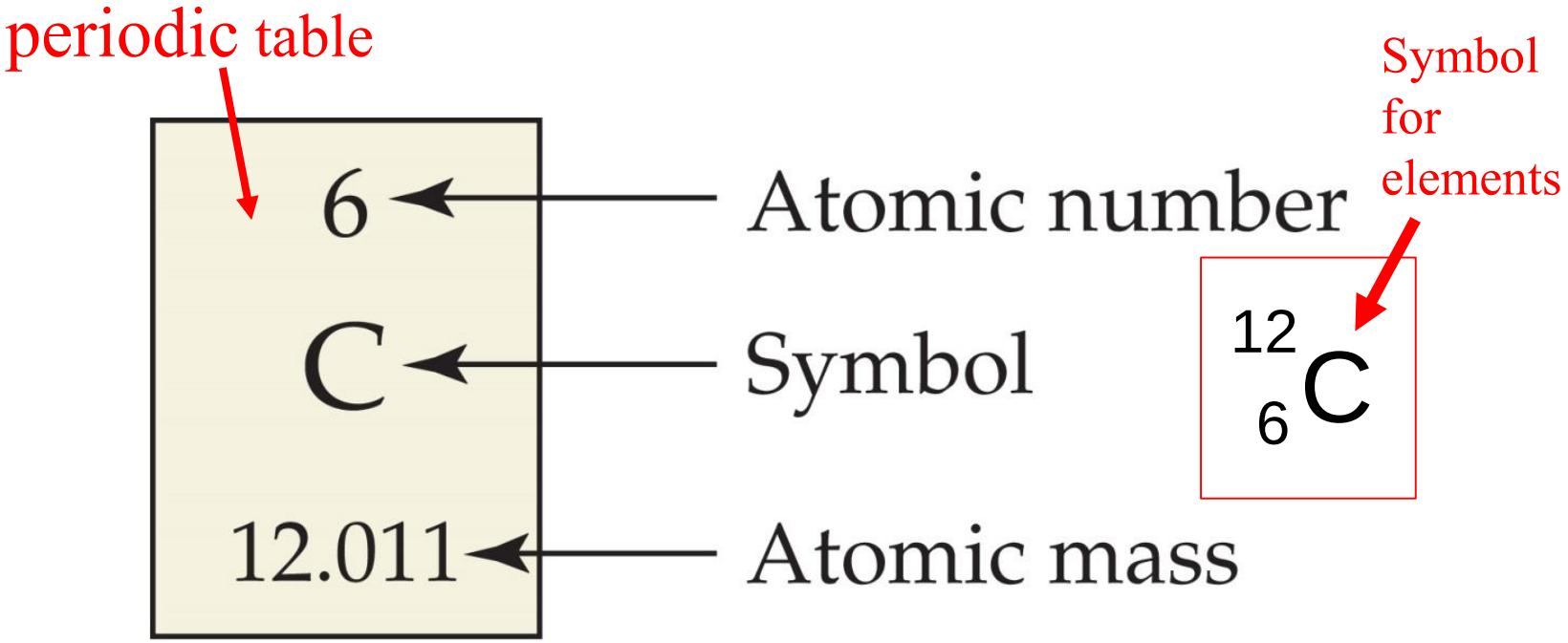
Atomic number

6 protons
6 electrons
8 neutrons

Atomic Masses

The mass of 1 atom of carbon-12 is **defined** to be 12 amu.

Atomic Mass: The weighted average of the isotopic masses of the element's naturally occurring isotopes



HW (do 1 & 3)

How many protons and neutrons are in the nucleus of each of the following atoms?

- In a neutral atom of each element, how many electrons are present? (look in periodic table)
- (**neutral atoms** have the same # of protons as electrons)

1. ^{79}Br
2. ^{81}Br
3. ^{239}Pu
4. ^{133}Cs

HW

- How many protons and neutrons are in the nucleus of each of the following atoms?
  - In a neutral atom of each element, how many electrons are present ?

1. ^{79}Br **35 p, 44 n, 35 e**
2. ^{81}Br **35 p, 46 n, 35 e**
3. ^{239}Pu **94 p, 145 n, 94 e**
4. ^{133}Cs **55 p, 78 n, 55 e**

Atomic Masses and the Mole

end 9/6 F G section

Why is the atomic mass of the element carbon 12.01 amu?

Carbon-12: 98.89% natural abundance 12 amu (infinite sig fig)
(98.89 / 100 = 0.9889)

Carbon-13: 1.11% natural abundance 13.0034 amu
(1.11 / 100 = 0.0111)

End 9/9 M D section

Mass of carbon = (12 amu)(0.9889) + (13.0034 amu)(0.0111)

= 11.87 amu + 0.144 amu

= 12.01 amu

HW Calculation of Average Atomic Mass from isotopic mass and % composition example: One isotope of gallium has atomic mass of 68.926 amu (atomic mass A) & makes up 60.3 % of natural gallium. Ga also has another isotope with atomic mass of 70.925 (atomic mass B) at 39.7% What is the average atomic mass of gallium based on the isotopic masses ? (next slide has answer)

HW Calculation of Average Atomic Mass from isotopic mass and % composition example: One isotope of gallium has atomic mass of 68.926 amu (atomic mass A) & makes up 60.3 % of natural gallium. Ga also has another isotope with atomic mass of 70.925 (atomic mass B) at 39.7% What is the average atomic mass of gallium based on the isotopic masses ?

average atomic mass =

isotope A isotope B

[(fraction)(atomic mass)] + [(fraction)(atomic mass)]

(0.603) (68.926) + (0.397) (70.925) = 69.7

41.562378 + 28.157225

Atomic Masses and the Mole

Avogadro's Number (N_A): One mole of any substance contains 6.022×10^{23} formula units.

Molar Mass: The mass in grams of one mole of any element. It is numerically equivalent to its atomic mass.

1 mole of ^{12}C weighs 12 grams

1 mole of ^{12}C has 6.022×10^{23} atoms of C

1 atom of ^{12}C weighs 12 amu

End 9/9M – sect F

Using Mole Definition:

HW: For the element calcium (Ca)

a) What is the atomic mass of calcium ? _____ amu

b) What is the molar mass of calcium ? _____ grams

c) How many atoms are in one mole of calcium ?

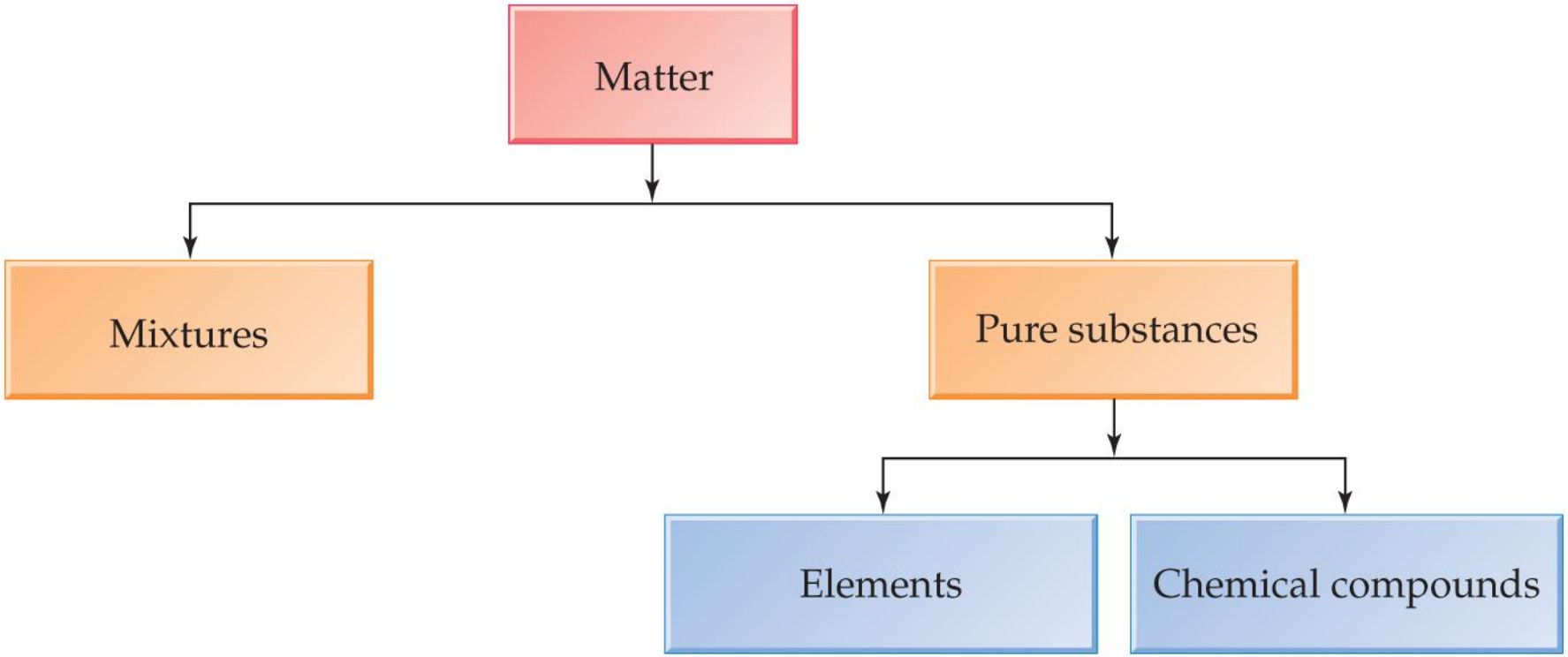
_____ atoms

d) How many moles are in 90.3 grams of calcium ?

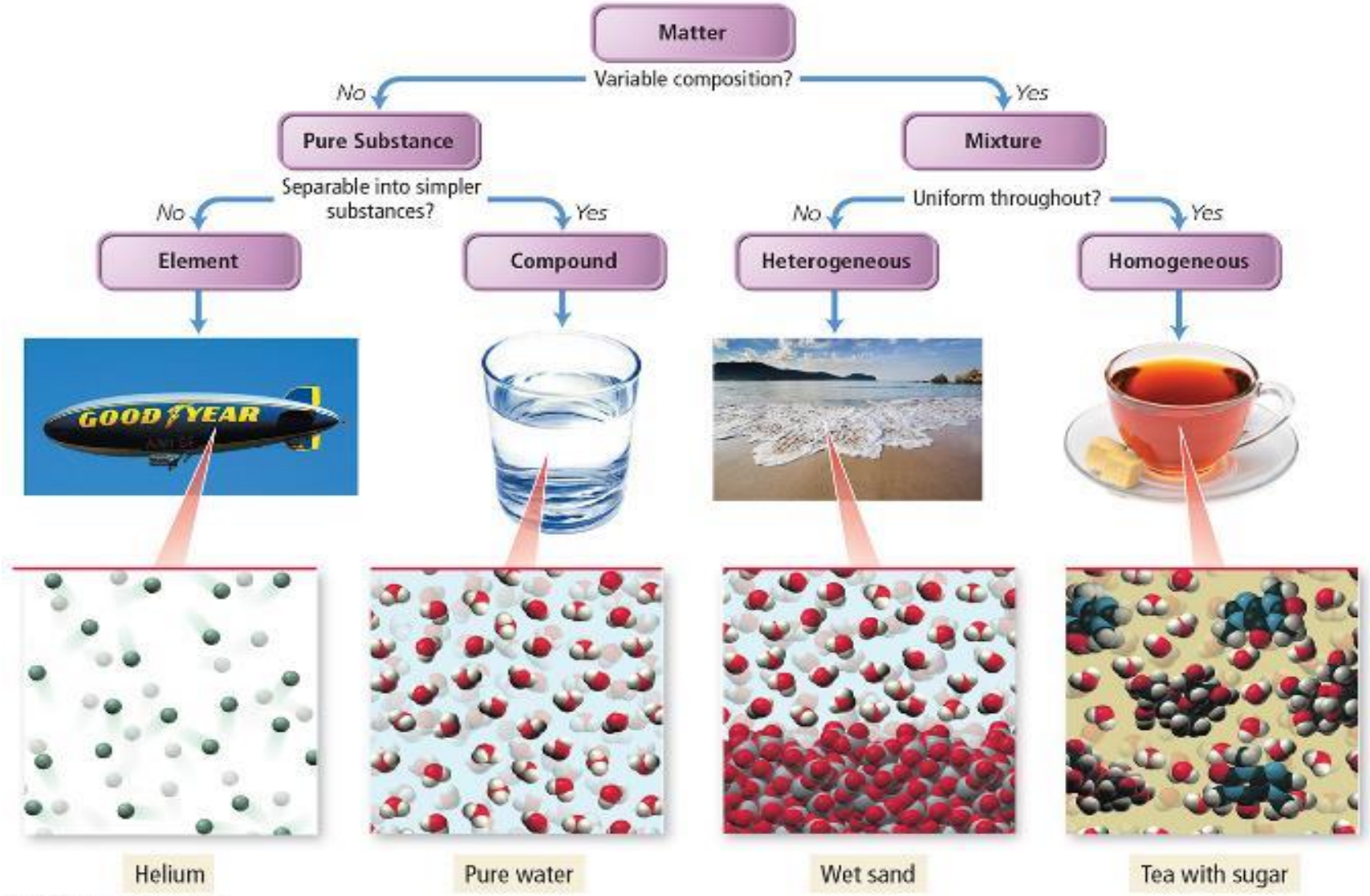
End 9/9 G section

e) How many atoms are in 90.3 grams of calcium ?

Mixtures and Chemical Compounds



Classification of Matter (examples)

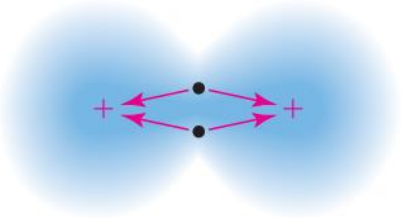


Molecules and Covalent Bonds

End 9/11 W D section

Covalent Bond: Results when two atoms share several (usually two) electrons. Typically a nonmetal bonded to a nonmetal. (friendly & cooperative – hold hands)

The two teams are joined together because both are tugging on the same rope.



Similarly, two atoms are joined together when both **nuclei (+)** tug on the same **electrons (dots)**.

Molecules and Covalent Bonds

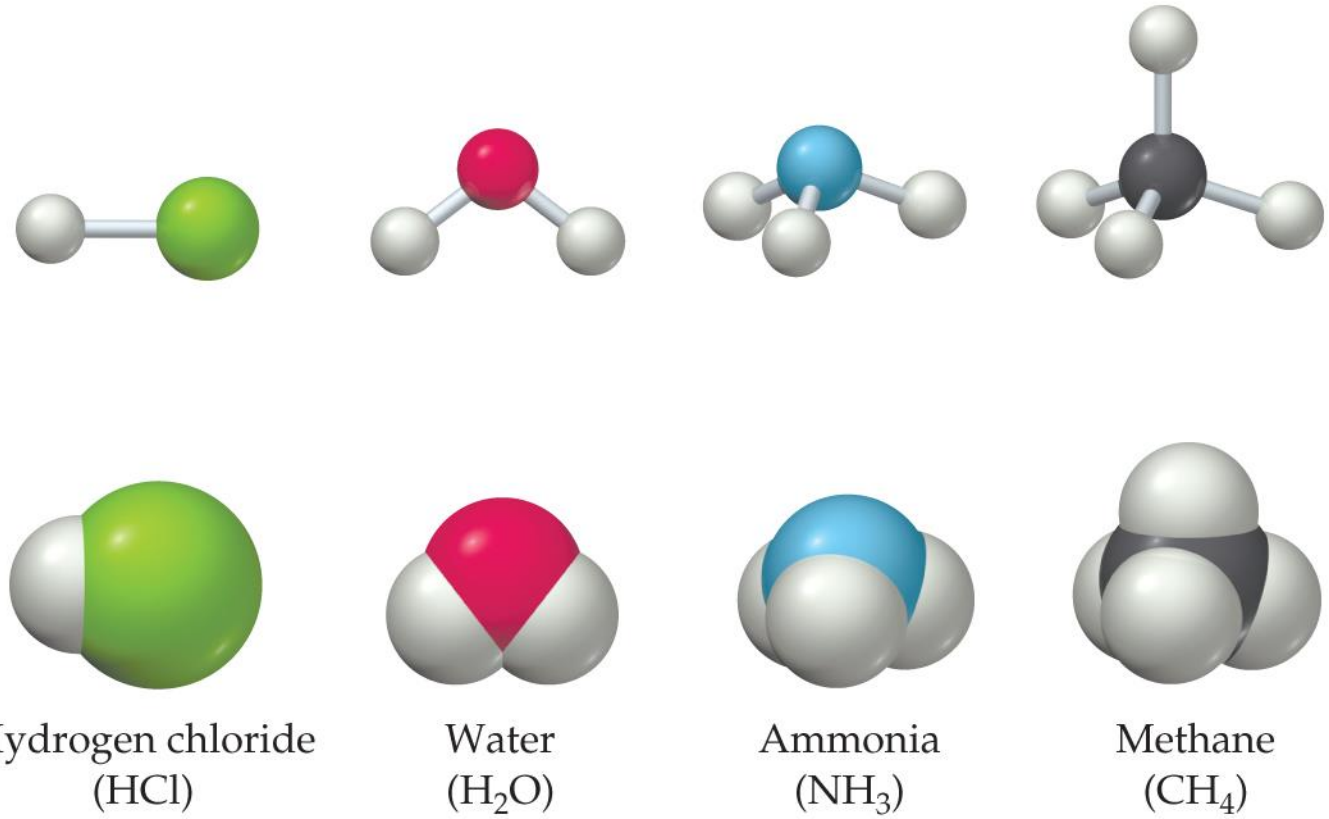
Covalent Bond: Results when two atoms share several (usually two) electrons. Typically a nonmetal bonded to a nonmetal.

Molecule: The unit of matter that results when two or more atoms are joined by covalent bonds.

Molecules and Covalent Bonds

Ball-and-stick models show atoms (spheres) joined together by covalent bonds (sticks).

Space-filling models portray the overall molecular shape but don't explicitly show covalent bonds.



Hydrogen chloride (HCl) | Water (H_2O) | Ammonia (NH_3) | Methane (CH_4)

Ions and Ionic Bonds

Ionic Bond: A transfer of one or more electrons from one atom to another. A strong electrical attraction between charged particles. Typically a metal bonded to a nonmetal. (selfish atoms – one atom gets all electrons, one atom loses all electrons)

Ion: A charged particle

Cation: A positively charged particle. Metals tend to form cations.

Anion: A negatively charged particle. Nonmetals tend to form anions.

ionic vs covalent

Ionic Compounds – metal with nonmetal combine two elements on opposite side of periodic table ex: $NaCl$, K_2S

Covalent Compounds – nonmetal with nonmetal, combine two elements close together on periodic table ex: CO_2, PCl_3

HW: Which of the following are ionic compounds and which are covalent compounds ?
(H is weird & is a nonmetal, H acts as if in group 7A)

a) K_2S

b) SO_2

c) P_2O_5

d) CH_4

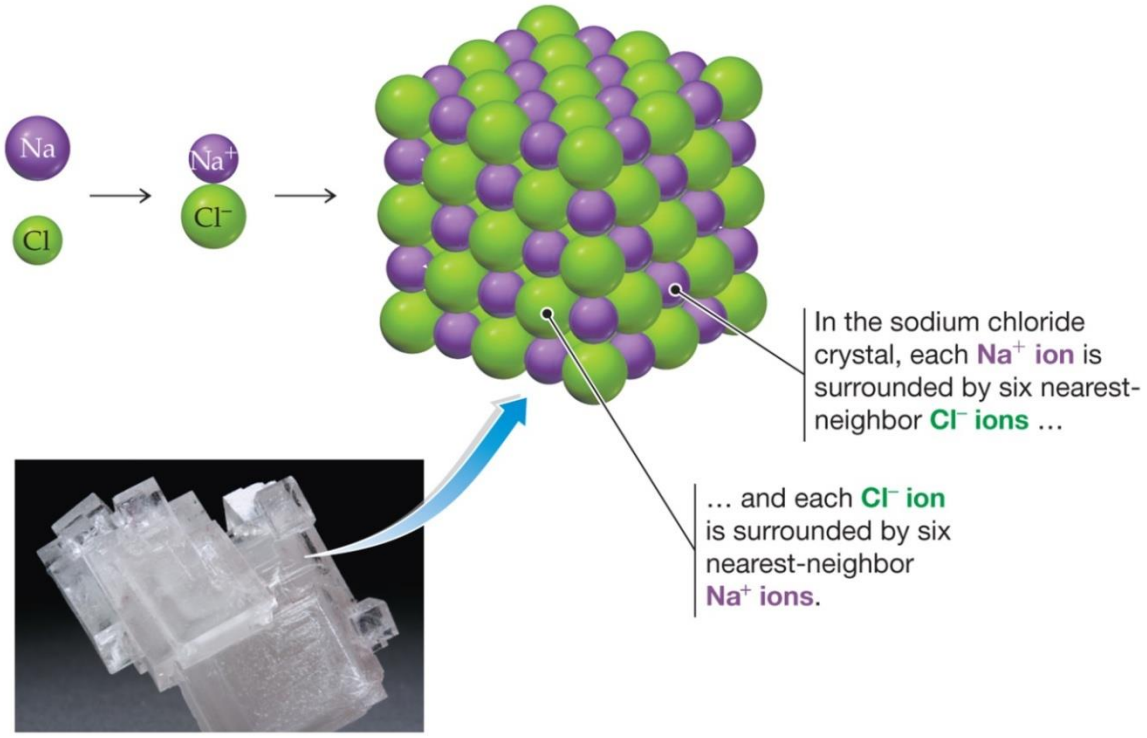
e) Cu O

f) H_2O

Ions and Ionic Bonds

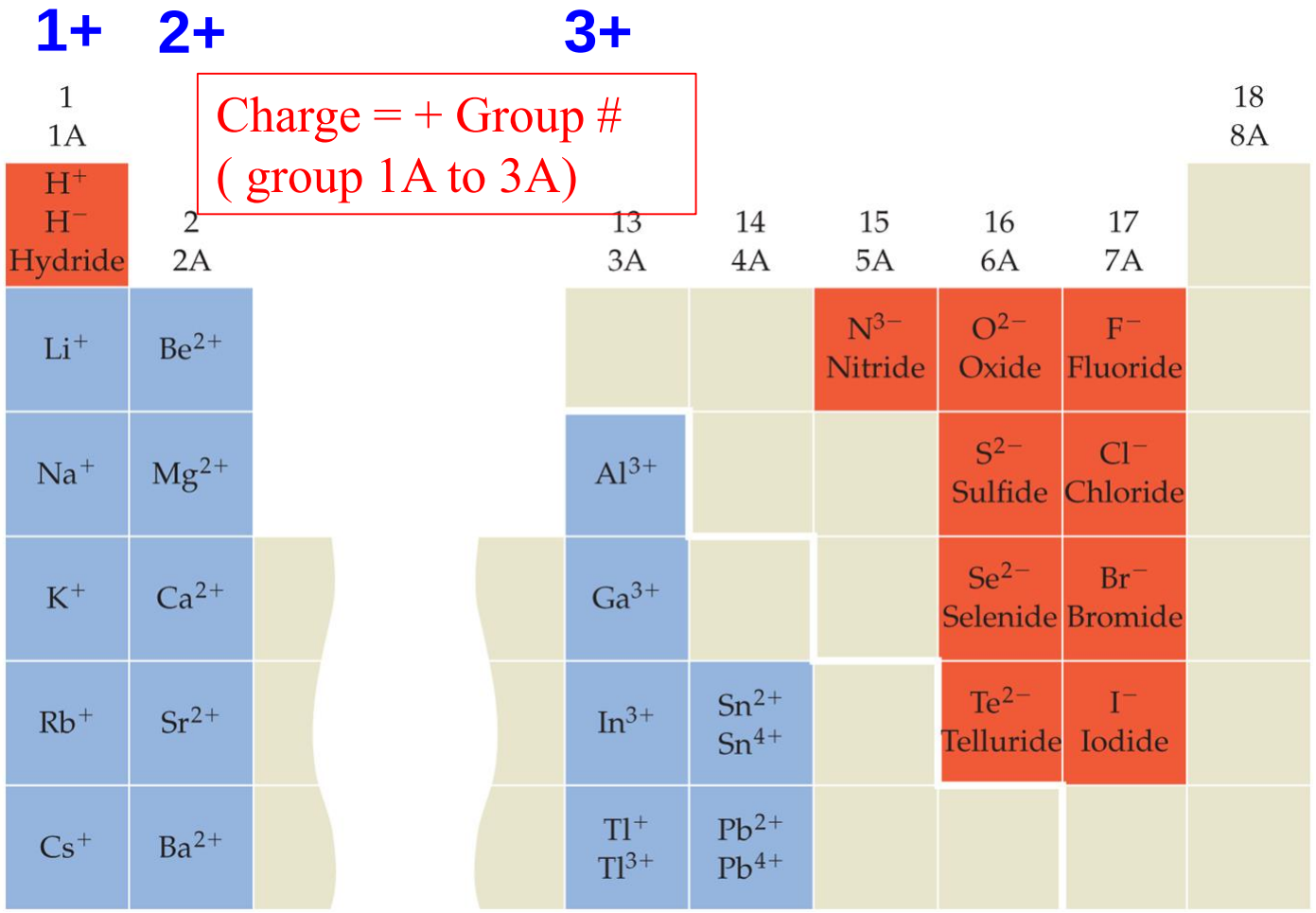
In the formation of sodium chloride, one electron is transferred from the sodium atom to the chlorine atom.

$$Na + \frac{1}{2} Cl_2 \longrightarrow Na^+ + Cl^-$$



Naming Chemical Compounds

Cation Charges for Typical Main-Group Ions

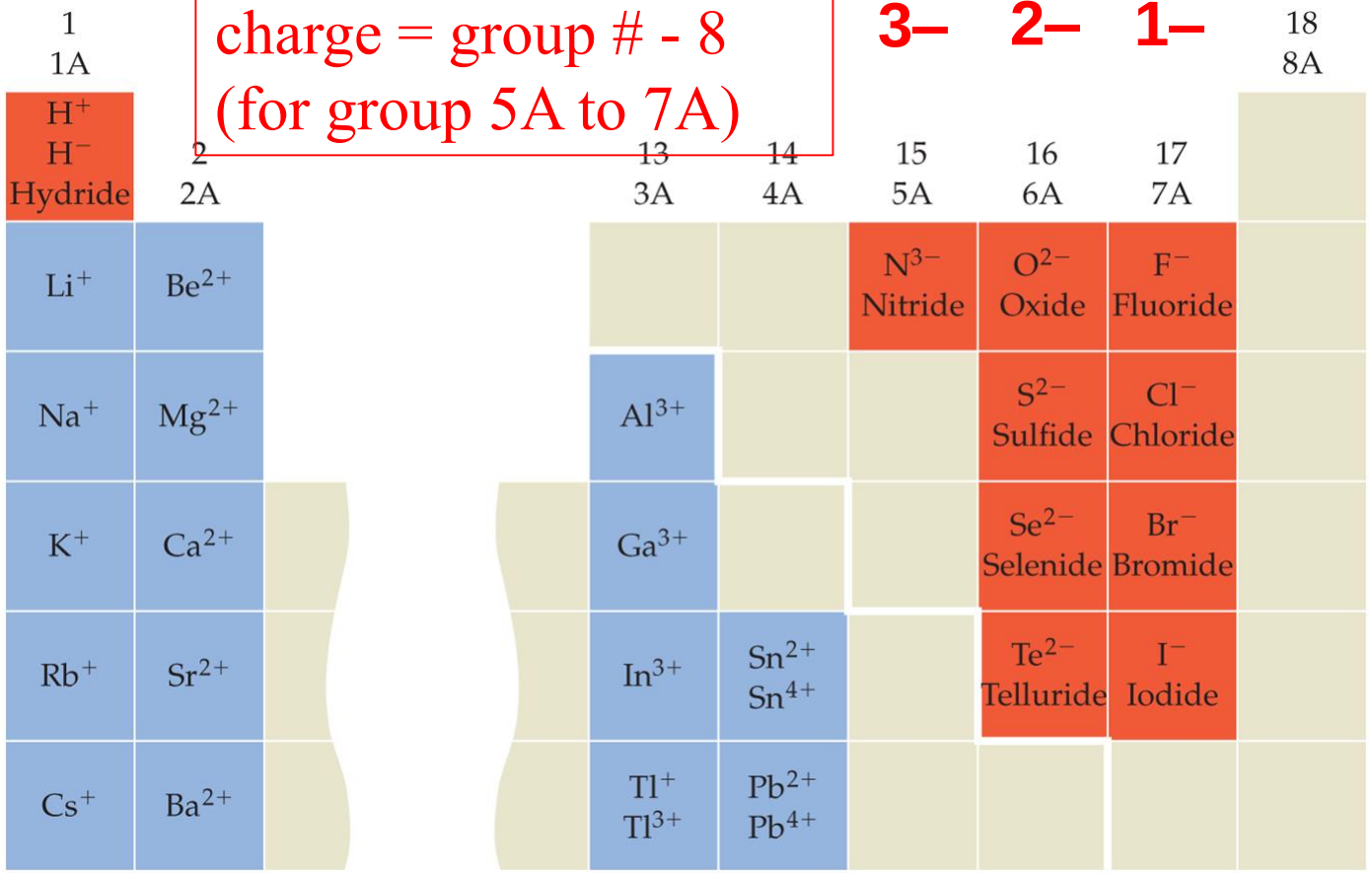


Naming Chemical Compounds

End class F section 9/11 Wed

Cation Charges for Typical Main-Group Ions

charge = group # - 8
(for group 5A to 7A)



HW: What is the charge on the ions formed from the following atoms ?

Na _____ group # ____charge

Ga _____ group # ____charge

N _____ group # ____charge

I _____ group # _____charge

As _____ group # _____charge

Naming Chemical Compounds

Ionic Compound: A neutral compound in which the total number of positive charges must equal the total number of negative charges. (metal element name + nonmetal element name – ending + ide)

Binary Ionic Compounds

9/12 R D sect

Sodium chloride (Chlorine – ending + ide)	Na^+	Cl^-	NaCl
Magnesium oxide (Oxygen – ending + ide)	Mg^{2+}	O^{2-}	MgO
Aluminum sulfide (sulfur – ending + ide)	Al^{3+}	S^{2-}	Al_2S_3

Naming Chemical Compounds

by inspection

Binary Ionic Compounds

Sodium chloride:	Na^+	Cl^-	NaCl
Magnesium oxide:	Mg^{2+}	O^{2-}	MgO
Aluminum sulfide:	Al^{3+}	S^{2-}	Al_2S_3

zero = (# Al) (charge Al) + (#S) (charge S)

HW: Write out the formula for the binary ionic compound formed from the following elements. Show work. (a) what are likely charges on all atoms (b) write out correct ionic compound formula including showing the subscript for how many of each ion you need for a neutral formula (zero charge formula) (c) give name Show work.

Ca & Cl

Rb & Se

Ga & O

9/11 W - G section

Naming Chemical Compounds

Some transition metals form more than one cation.

3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B
Sc^{3+}	Ti^{3+}	V^{2+} V^{3+}	Cr^{2+} Cr^{3+}	Mn^{2+}	Fe^{2+} Fe^{3+}	Co^{2+}	Ni^{2+}	Cu^{+} Cu^{2+}	Zn^{2+}
Y^{3+}					Ru^{3+}	Rh^{3+}	Pd^{2+}	Ag^{+}	Cd^{2+}
									Hg^{2+} $(Hg_2)^{2+}$

Naming Chemical Compounds

Use Roman numerals in parentheses to indicate the charge on metals that form more than one kind of cation. [for transition metal & main gp (Sn, Pb, Tl)]

Binary Ionic Compounds

Iron(III) oxide:	Fe^{3+}	O^{2-}	Fe_2O_3
Tin(II) chloride:	Sn^{2+}	Cl^-	$SnCl_2$
Lead(II) fluoride:	Pb^{2+}	F^-	PbF_2

Naming Chemical Compounds

Binary Molecular Compounds

TABLE 2.6 Numerical Prefixes for Naming Compounds

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

syllabus to memorize
table from p. 65

Because nonmetals often combine with one another in different proportions to form different compounds, numerical prefixes are usually included in the names of binary molecular compounds. (covalent molecules)

Naming Chemical Compounds

N_2F_4

The prefix is added to the front of each name to indicate the number of each atom.

Dinitrogen **tetra**fluor**ide**

9/13F F section

Naming Chemical Compounds

Binary Molecular Compounds

Whenever the prefix ends in *a* or *o* and the element name begins with a vowel, drop the *a* or *o* in the prefix.

N_2O_4 Dinitrogen tetroxide

Whenever the prefix for the **first** element is *mono-*, drop it.

CO_2 Carbon dioxide

CO Carbon monoxide

Naming Chemical Compounds

TABLE 2.5 Some Common Polyatomic Ions

Formula	Name
Cation	
NH_4^+	Ammonium *
Singly charged anions	
$CH_3CO_2^-$	Acetate *
CN^-	Cyanide
ClO^-	Hypochlorite
ClO_2^-	Chlorite
ClO_3^-	Chlorate
ClO_4^-	Perchlorate
$H_2PO_4^-$	Dihydrogen phosphate
HCO_3^-	Hydrogen carbonate (or bicarbonate) *
HSO_4^-	Hydrogen sulfate (or bisulfate)
OH^-	Hydroxide *
MnO_4^-	Permanganate

Formula	Name
Singly charged anions (continued)	
NO_2^-	Nitrite
NO_3^-	Nitrate *
Doubly charged anions	
CO_3^{2-}	Carbonate *
CrO_4^{2-}	Chromate
$Cr_2O_7^{2-}$	Dichromate
O_2^{2-}	Peroxide
HPO_4^{2-}	Hydrogen phosphate
SO_3^{2-}	Sulfite
SO_4^{2-}	Sulfate *
$S_2O_3^{2-}$	Thiosulfate
Triply charged anion	
PO_4^{3-}	Phosphate *

syllabus to memorize list p. 63 (for quiz & test 1 – memorize name, formula & charge for those with *)

Naming Chemical Compounds

Polyatomic Ionic Compounds

Sodium hydroxide:	Na^+	OH^-	$NaOH$
Magnesium carbonate:	Mg^{2+}	CO_3^{2-}	$MgCO_3$
Sodium carbonate:	Na^+	CO_3^{2-}	Na_2CO_3
Iron(II) hydroxide:	Fe^{2+}	OH^-	$Fe(OH)_2$

In summary for naming:

- **Ionic** – metal nonmetal (if either is a polyatomic ion, use the name of the polyatomic ion instead of the name of the element)

  give element name for metal [If variable charge (most transition metals & Sn, Pb & Tl) metal – use charge in parenthesis]

  give element name for nonmetal – ending + ide

  do **NOT** use number prefixes

- **Covalent** – nonmetal-1 nonmetal-2 (same as ionic but use # prefix)

  give element name for nonmetal-1

  give element name for nonmetal-2 – ending + ide

  use number prefixes

  (mono, di, tri, tetra, penta, hexa, hepta, octa, etc)

End 9/13 G sect

Ionic vs Covalent Naming

- $CaCl_2$ vs PCl_3
- Ionic vs covalent
- (same naming but covalent use # prefix)
- calcium chlorine – ine + ide

  calcium chloride

- phosphorus chlorine – ine + ide (use # prefix)

  phosphorus trichloride

HW: Naming Ionic Binary Compounds

1. Give the systematic name for each of the following compounds:
   a. $CoBr_2$
   b. $CaCl_2$
2. Given the following systematic names, write the formula for each compound:
   a. Chromium(III) chloride
   b. Gallium iodide

HW: Naming Ionic Binary Compounds

1. Give the systematic name for each of the following compounds:
   a. $CoBr_2$ cobalt (II) bromide
   b. $CaCl_2$ calcium chloride
2. Given the following systematic names, write the formula for each compound:
   a. Chromium(III) chloride $Cr\ Cl_3$
   b. Gallium iodide $Ga\ I_3$

HW: Naming Compounds Containing Polyatomic Ions

1. Give the systematic name for each of the following compounds:
   a. Na_2SO_4
   b. $Mn(OH)_2$
2. Given the following systematic names, write the formula for each compound: (formula must equal zero charge overall)
   a. Sodium carbonate
   b. Sodium phosphate

HW: Naming Compounds Containing Polyatomic Ions

1. Give the systematic name for each of the following compounds:
   a. Na_2SO_4 sodium sulfate
   b. $Mn(OH)_2$ manganese (II) hydroxide
2. Given the following systematic names, write the formula for each compound: (formula musts equal zero charge overall)
   a. Sodium carbonate Na_2CO_3
   b. Sodium phosphate Na_3PO_4

HW: Naming Covalent Binary Compounds

1. Name each of the following compounds:
   a. PCl_5
   b. PCl_3
   c. SO_2
2. From the following systematic names, write the formula for each compound:
   a. Sulfur hexafluoride
   b. Sulfur trioxide

Naming Covalent Binary Compounds

1. Name each of the following compounds:
   a. PCl_5 phosphorus pentachloride
   b. PCl_3 phosphorus trichloride
   c. SO_2 sulfur dioxide
2. From the following systematic names, write the formula for each compound:
   a. Sulfur hexafluoride SF_6
   b. Sulfur trioxide SO_3