Welcome to CEM 141
Dr. JAMES GEIGER

geigerj@msu.edu

Office: Room 9 Chemistry

Office Hours:MWF   1:30pm - 2:30pm
and by appointment

CEM 141 website

www.chemistry.msu.edu

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click CEM 141

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Recitation

- No recitation this week
- Recitation begins next week, after Labor Day
- Work in small groups to solve problems
- Earn a maximum of 5 points per recitation
- Earn a maximum of 50 points for the semester

CONNECT Problem Sets

- You MUST purchase an CONNECT access code
- Problem sets are due Saturdays by 8:00am
- The first problem set is due Saturday, September 8th
- Instructions for registering your access code can be found on the CEM 141 website

Do you need help with CONNECT?

Representatives from McGraw Hill are outside of rooms 103 and 113 in the Chemistry Building this week to help you get started using CONNECT.

Examinations

Exam 1: Monday, September 24th at 7:15pm

Exam 2: Monday, October 22nd at 7:15pm

Exam 3: Monday, November 19th at 7:15pm

Final Exam: Thursday, December 13th at 7:45AM

Grades

Your grade is determined by the total points you earn out of 1000:

- In-Term Exam 180 points each
- Final Exam 250 points
- CONNECT Sets 160 points
- Recitation Problems 50 points

Grades

The grade scale shown below is fixed, guaranteed, and will NOT be curved:

1000 - 800 points	4.0	619 - 560 points	2.0
799 - 740 points	3.5	559 - 500 points	1.5
739 - 680 points	3.0	499 - 440 points	1.0
679 - 620 points	2.5	439 - 0 points	0.0

Lecture notes 1
Review of Math and calculations

- Units of measurement: SI
- Basic SI measurements
  - Mass (Kg) kilogram
  - Length (m) meter
  - Time (s) second
  - Temperature (K) Kelvin
  - Amount mole
  - Current (A) ampere

Common Derived Units

- Velocity = length/time m/s
- Acceleration = veloicity/time m/s^2
- Force = mass *acceleration = kg m/s^2 Newton (N)
- Energy = force*distance = Nm = Kg m^2/s^2 = Joule (J)
- Power = energy/time = J/s = = Kg m/s^3= Watt (W)
- Frequency = 1/time = s^{-1} = Hertz (Hz)
- Pressure = force/area = Nm^{-2} = Kg/m s^{-2} = Pascal (Pa)

Prefixes

- pico 10^{-12}
- micro 10^{-6}
- milli 10^{-3}
- Kilo 10^{3}
- mega 10^{6}

Significant Figures

- Answers should always be rounded to appropriate significant figures.

Significant Figures

- The term significant figures refers to digits that were measured.
- When rounding calculated numbers, we pay attention to significant figures so we do not overstate the precision of our answers.

Significant Figures

1. All nonzero digits are significant. (sig figs in red)
   423.444
2. Zeroes between two significant figures are themselves significant.
   42,300045   42,340.0025
3. Zeroes at the beginning of a number are never significant.
   00042345
4. Zeroes at the end of a number are significant if a decimal point is written in the number.
   423000 versus: 423000. or: 423000.000

Significant Figures

- When addition or subtraction is performed, answers are rounded to the least significant decimal place.

  24.245
  +22.33488
  ———
  46.57988 = 46.580

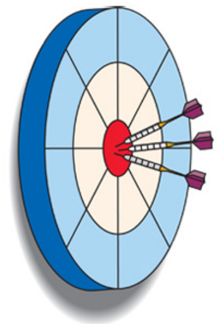
- When multiplication or division is performed, answers are rounded to the number of digits that corresponds to the *least* number of significant figures in any of the numbers used in the calculation.

  35.8750
  X40.006800
  ———
  1435.24395 = 1435.24

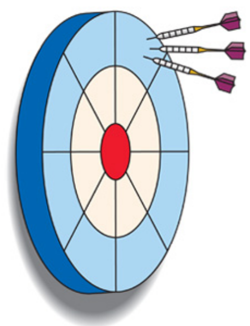
Accuracy versus Precision

- Accuracy How close a measurement is to the true value. (How right you are)

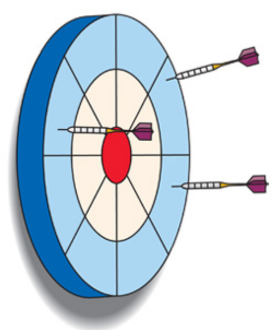
- Precision How close measurements are to each other. (Reproducability)



Good accuracy
Good precision



Poor accuracy
Good precision



Poor accuracy
Poor precision

Dimensional analysis

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What do virtually all problems in chemistry have in common?

Dimensional analysis

Convert centimeters to feet: 1 cm = ? feet
Know: 2.54 cm = 1 in, 12 in = 1 foot.

$$\frac{1in}{2.54cm}\left(\frac{1\,ft}{12in}\right) = 0.032\,\frac{ft}{cm}$$

Dimensional Analysis

- What do I need on top?
- What do I need on the bottom?
- What do I know?
- How do I get there?
- Note: You will always be given the conversion factors you need, you don't have to memorize them.

Dimensional analysis, examples

The speed of light is 2.998x10^{8}m/s. What is it in km/hr?

Know: 1 km =1000m, 1m=100cm 60 min =1 hr, 60 sec =1 min

What do I need on top? *meters*

What do I need on the bottom? *hours*

$$2.998x10^8 \frac{\cancel{cm}}{\cancel{s}}\left(\frac{1\cancel{m}}{100\cancel{cm}}\right)\left(\frac{km}{1000\cancel{m}}\right)\left(\frac{60\cancel{s}}{1\cancel{\min}}\right)\left(\frac{60\cancel{\min}}{1hr}\right) = 1.079x10^7 \frac{km}{hr}$$

Dimensional analysis, examples

The Vehicle Assembly Building (VAB) at the Kennedy Space Center has a volume of: 3,666,500m^3. What is it in liters?

Know: 1 L = 1 dm^3, 1dm = 0.1 m

What do I need on top? *Liters*

What do I need on the bottom? *nothing*

$$3{,}666{,}500\cancel{m}^3 = \left(\frac{\cancel{dm}}{0.1\cancel{m}}\right)^3 \left(\frac{1L}{1\cancel{dm}^3}\right) = 3.6665x10^9\, L$$

Dimensional analysis, examples

An individual suffering from high cholesterol has 232 mg cholesterol per 100.0 mL of blood. How many grams of cholesterol in the blood, assuming a blood volume of 5.2 L?

Know: 1 L = 1000 mL, 1g = 1000mg

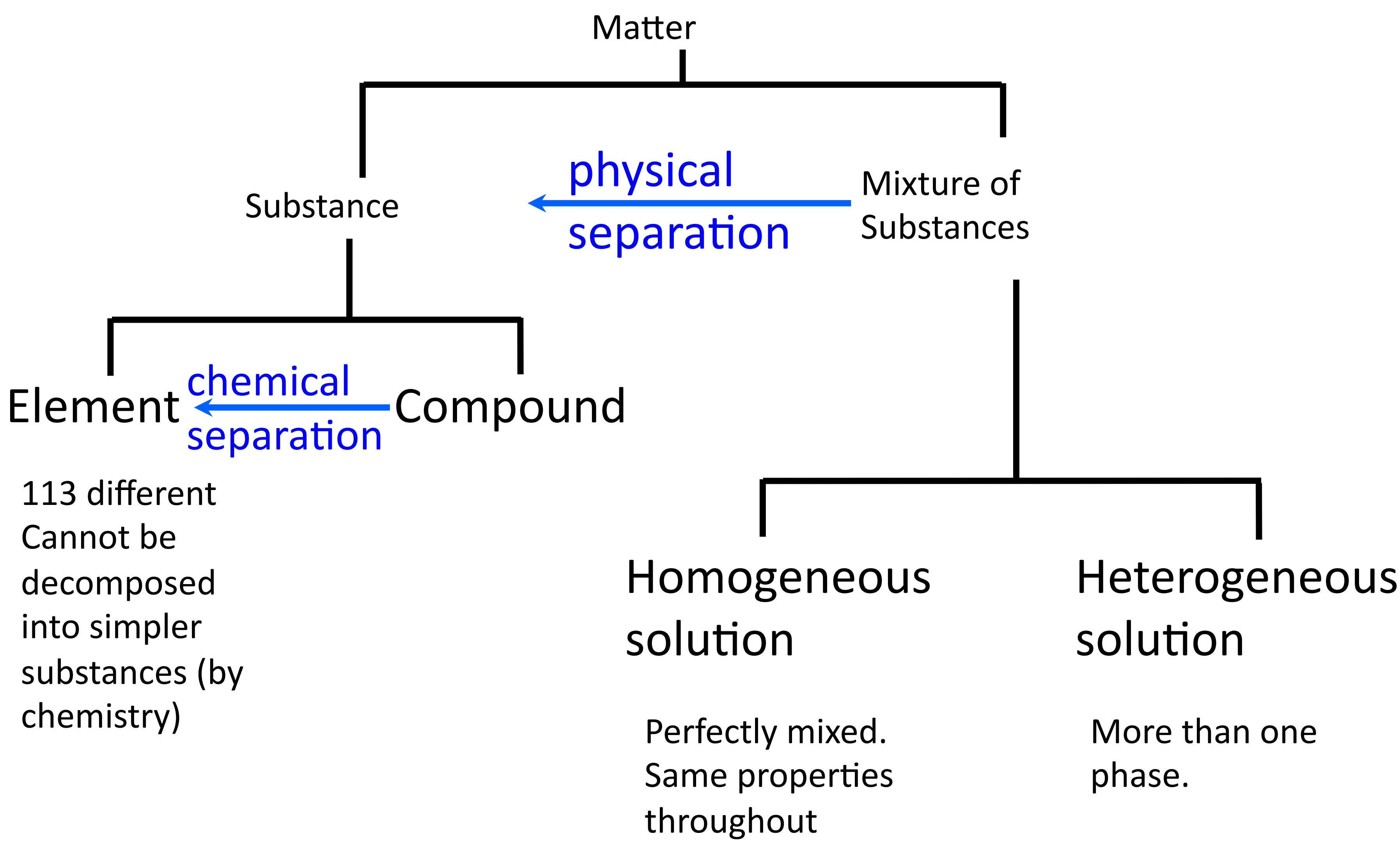
What do I need on top? *grams*

What do I need on the bottom? *patient*

$$232\frac{\cancel{mg}}{100.0\cancel{mL}} = \left(\frac{1000\cancel{mL}}{\cancel{1L}}\right)\left(\frac{5.2\cancel{Lblood}}{patient}\right)\left(\frac{1g}{1000\cancel{mg}}\right) = 12.\frac{g}{patient}$$

Scientific notation

- The custom is to write answers in scientific notation
- Means that only 1 number after decimal
- Examples:
- $63.51 = 6.351 \times 10^{1}$
- $0.0271 = 2.71 \times 10^{-2}$
- $10068 = 1.0068 \times 10^{4}$


Matter
Substance
physical separation
Mixture of Substances
Element
chemical separation
Compound
113 different Cannot be decomposed into simpler substances (by chemistry)
Homogeneous solution
Heterogeneous solution
Perfectly mixed. Same properties throughout
More than one phase.

Elements

- Cannot be decomposed by chemistry
- Each element has a symbol, 1 or 2 letters
- The smallest particle is an atom.
- The **Atom** is indivisible by chemistry
- Elements are found in nature as:
  - Diatomic molecules (H_2 N_2 F_2 Cl_2)
  - Discrete molecular clusters (P_4 S_8)
  - Solids (the metals, gold Au, sodium N, etc.

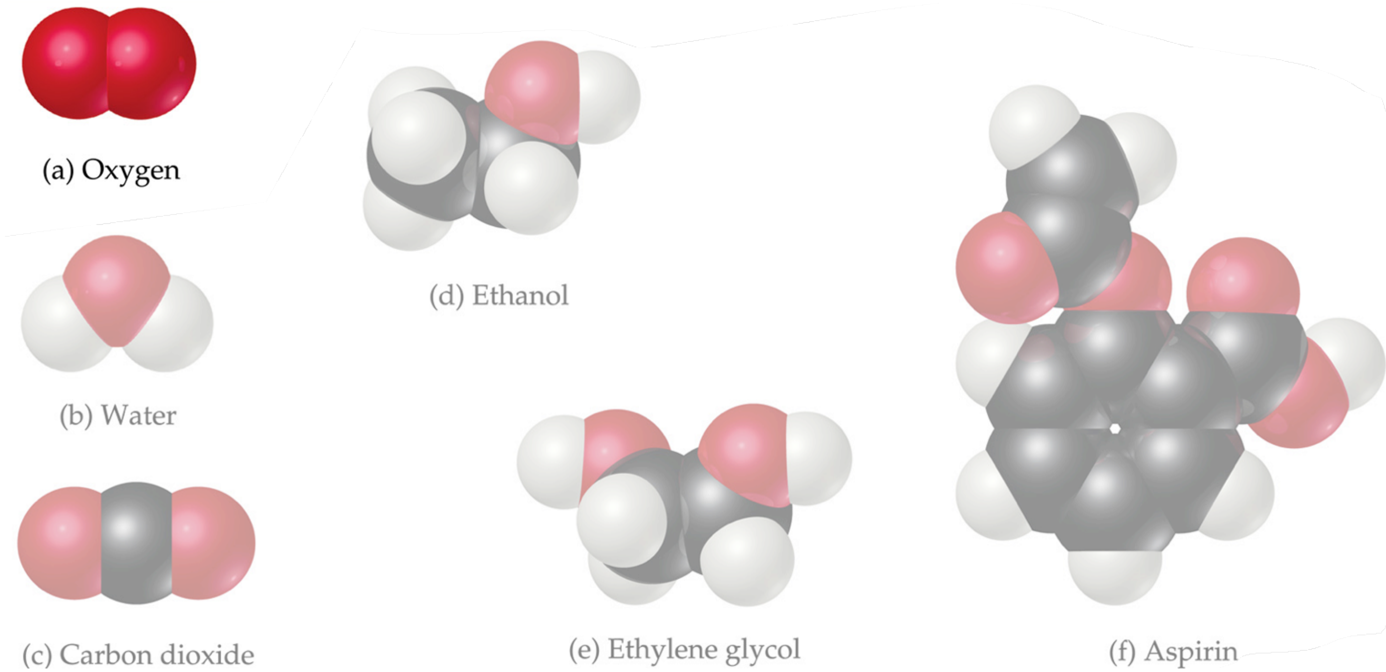
- $H_2 + 1/2O_2 \longrightarrow H_2O$

Elements compound

unique properties

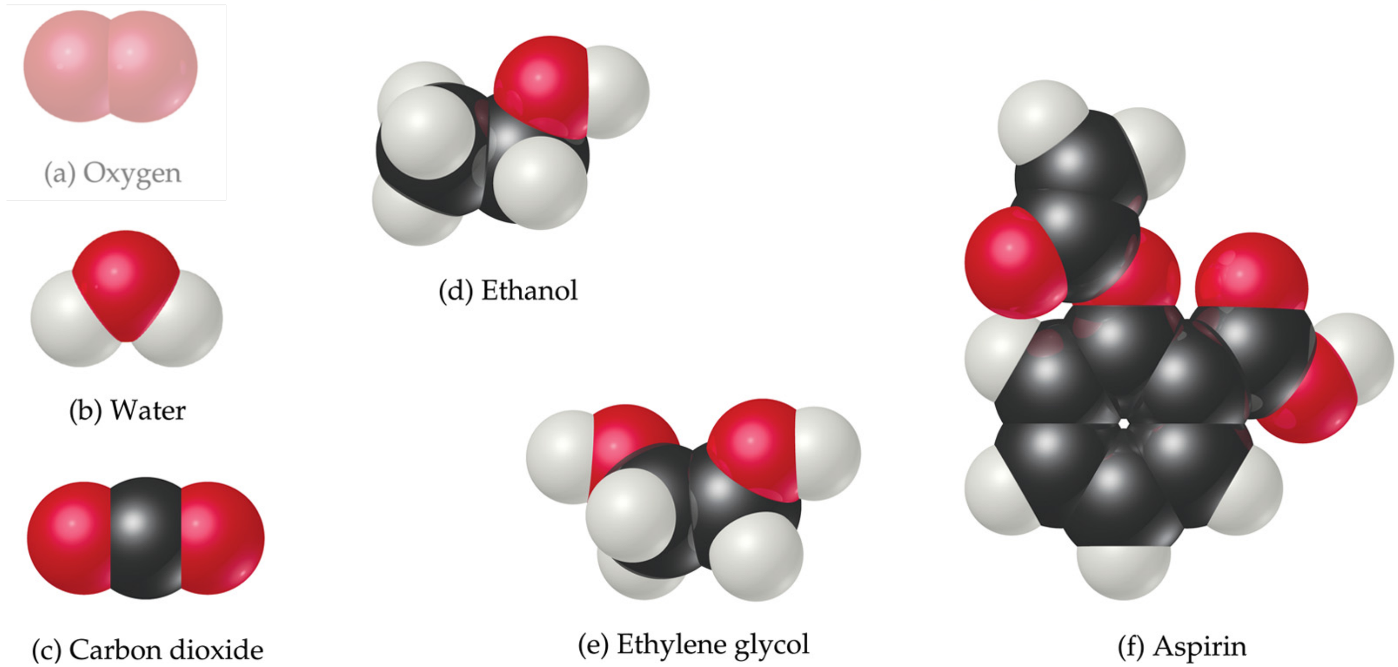
can be decomposed into simpler substances

Molecules



- Each element is made of the same kind of atom.
- Molecule of oxygen, cluster of 2 O atoms tightly bound.

Molecules



• Molecular compounds, made of two or more different kinds of elements tightly bound together.

Compounds

- Two main types
  - Molecular
  - Ionic
  - Defined by what holds the atoms together

Each compound has a formula indicating the composition (amount of each element) in the compound.

- H_2O
- CO_2 Molecular compounds
- CH_4
- NaCl Ionic Compounds
- CuCl

Properties of Matter

- Physical Properties:
  - □ Must be observed without changing a compound/ element into another compound/element.
    - **Boiling point, density, mass, volume, etc.**
- Chemical Properties:
  - □ Can *only* be observed when a compound/element is changed into another compound/element.
    - **Flammability, corrosiveness, reactivity with acid, etc.**

Properties of Matter

- Intensive Properties:
  - Independent of the amount of the matter that is present.
    - **Density, boiling point, color, etc.**
- Extensive Properties:
  - Dependent upon the amount of the matter present.
    - **Mass, volume, energy, etc.**

Changes of Matter

- Physical Changes:
  - □ Changes in matter that do not change the composition of a substance.
    - **Changes of state, temperature, volume, etc.**
- Chemical Changes:
  - □ Changes that result in new substances.
    - **Combustion, oxidation, decomposition, etc.**

Atomic Theory of Matter

The theory of atoms:

Original to the Greeks

Leuccipus, Democritus and Lucretius

(Aristotle thought they were nuts)

He believed that one could divide up a piece of matter an infinite number of times, that is, one never came up with a piece of matter that could not be further divided. He suggested that everything in the world was made up of some combination of four elements: earth, fire, water, and air. The elements were acted upon by the two forces of gravity and levity. Gravity was the tendency for earth and water to sink, and levity the tendency for air and fire to rise.

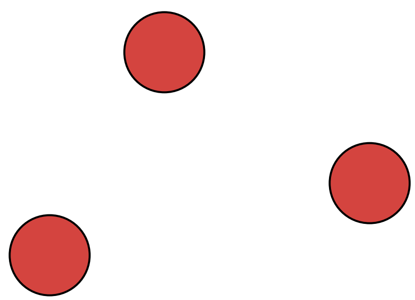
John Dalton (1805-1808)

Revived the idea and made it **science** by measuring the atomic weights of 21 elements.

That's the key thing because then you can see how elements combine.

Dalton’s Postulates

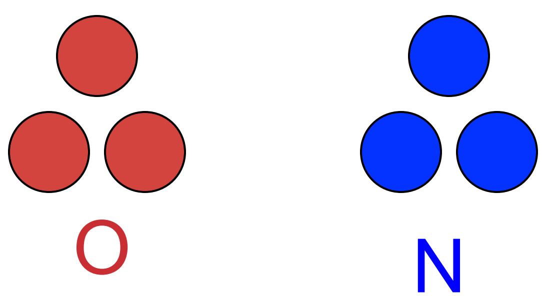
Each element is composed of extremely small particles called atoms.



Tiny balls make up the world

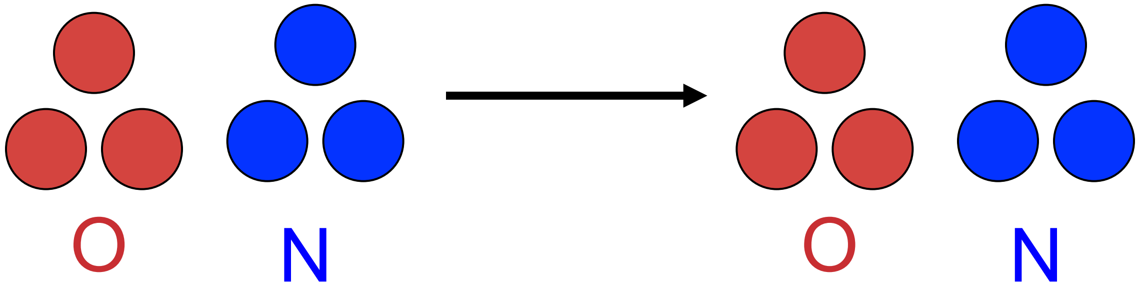
Dalton's Postulates

All atoms of a given element are identical to one another in mass and other properties, but the atoms of one element are different from the atoms of all other elements.



Dalton's Postulates

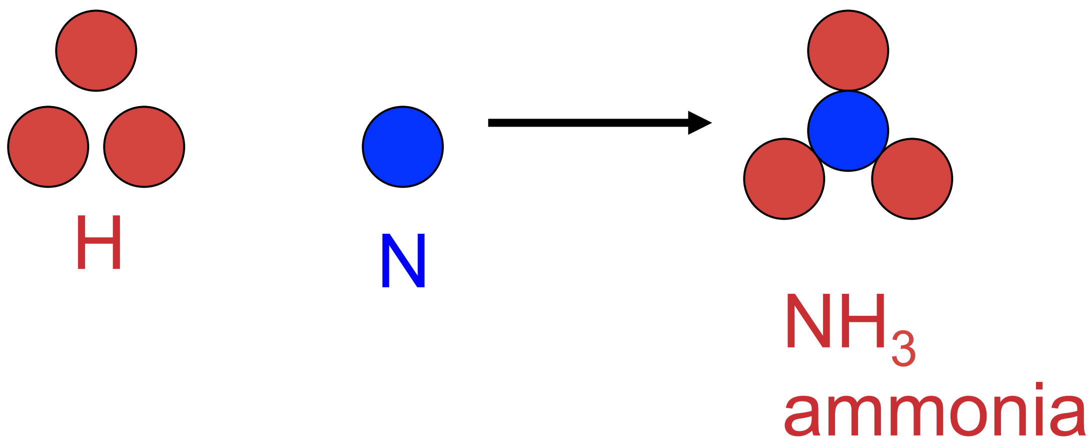
Atoms of an element are not changed into atoms of a different element by chemical reactions; atoms are neither created nor destroyed in chemical reactions. (As far as Dalton knew, they couldn't be changed at all).



Red O's stay Os and aqua N's stay N's.

Dalton's Postulates

Compounds are formed when atoms of more than one element combine; a given compound always has the same relative number and kind of atoms.

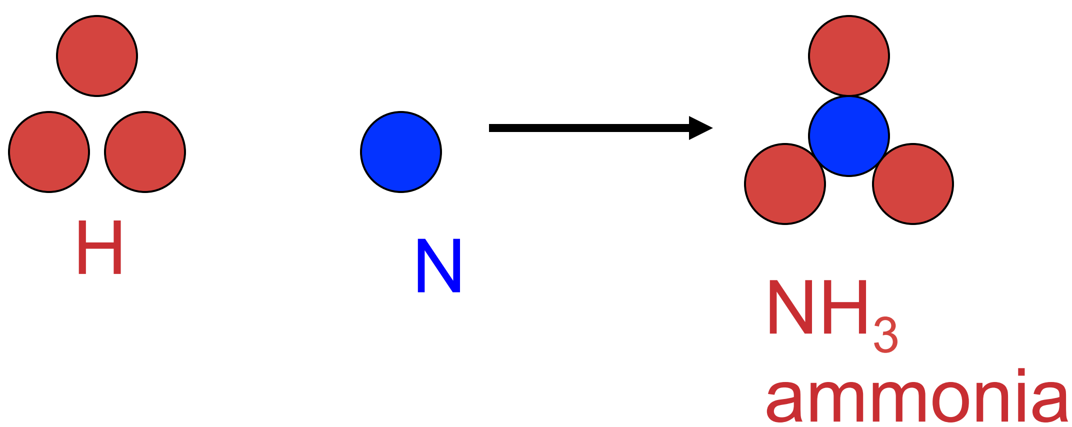


Chemistry happens when the balls rearrange

Law of Constant Composition

Joseph Proust (1754–1826)

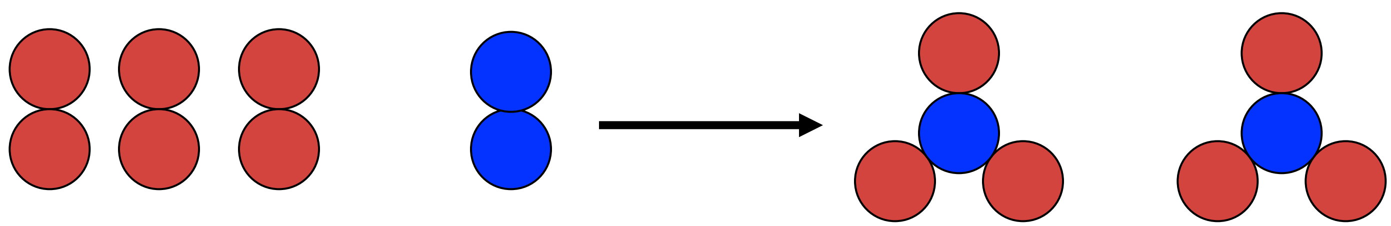
- Also known as the law of definite proportions.
- The elemental composition of a pure substance never varies.
- The relative amounts of each element in a compound doesn't vary.



ammonia always has 3 H and 1 N.

Law of Conservation of Mass

The total mass of substances present at the end of a chemical process is the same as the mass of substances present before the process took place.

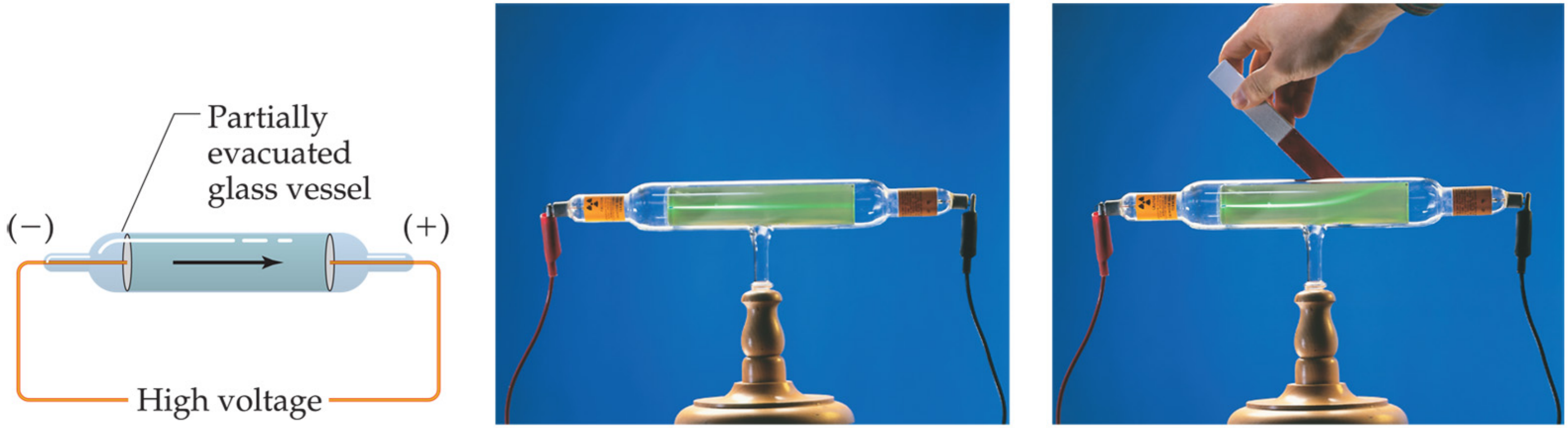


$3H_2 + N_2$ $\qquad$ $2NH_3$

ammonia

The atoms on the left all appear on the right

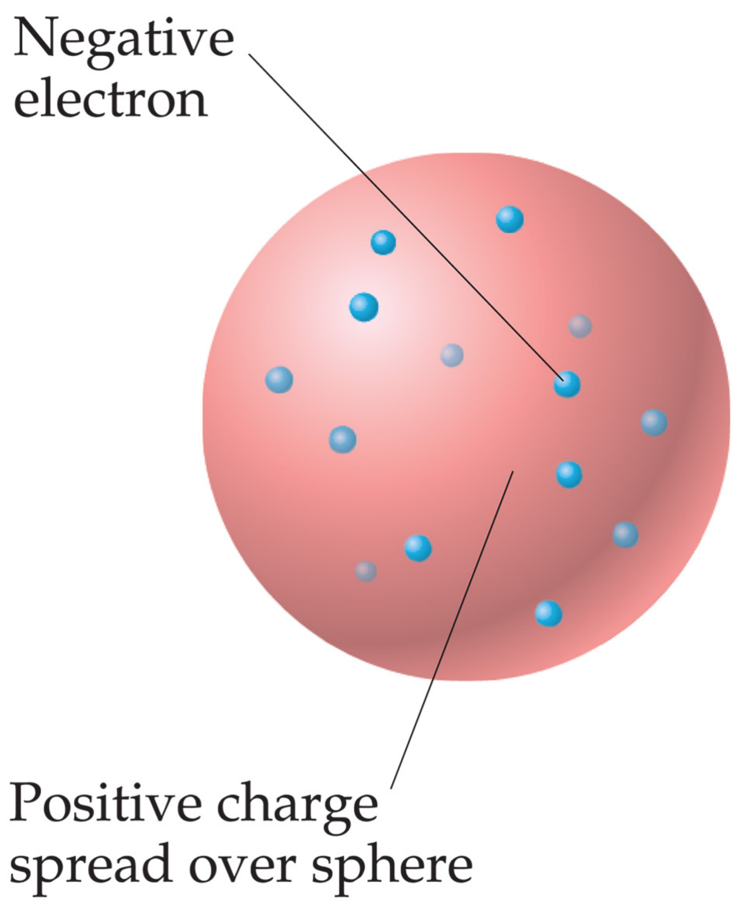
The Electron



(a) (b) (c)

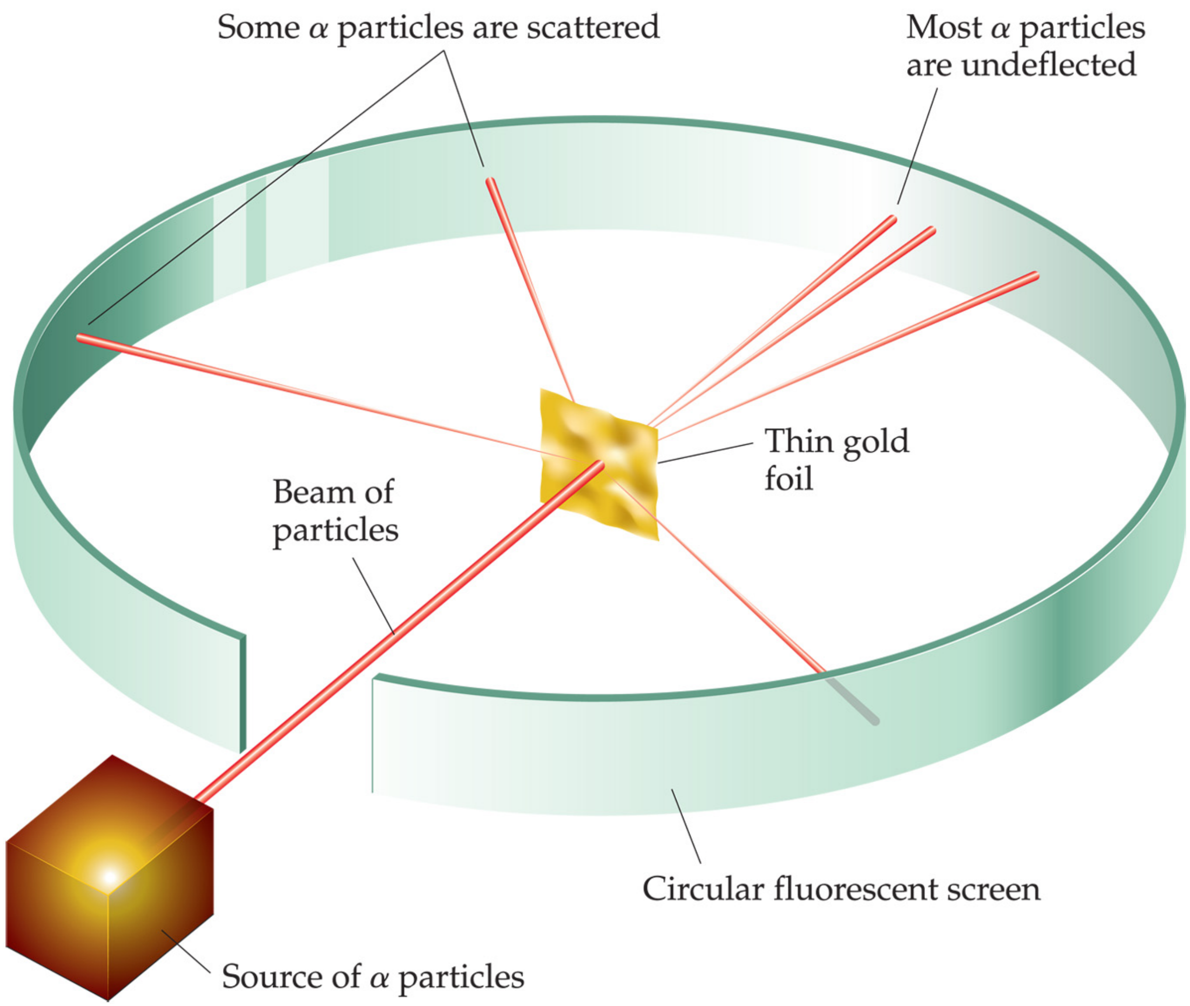
- Streams of negatively charged particles were found to emanate from cathode tubes.
- J. J. Thompson (1897).
- Maybe atoms weren't completely indivisible after all.

The Atom, circa 1900:



- “Plum pudding” model, put forward by Thompson.
- Positive sphere of matter with negative electrons imbedded in it.
- most of the volume = positive stuff because most of the mass is positive
- Expectation: density more or less uniform throughout.

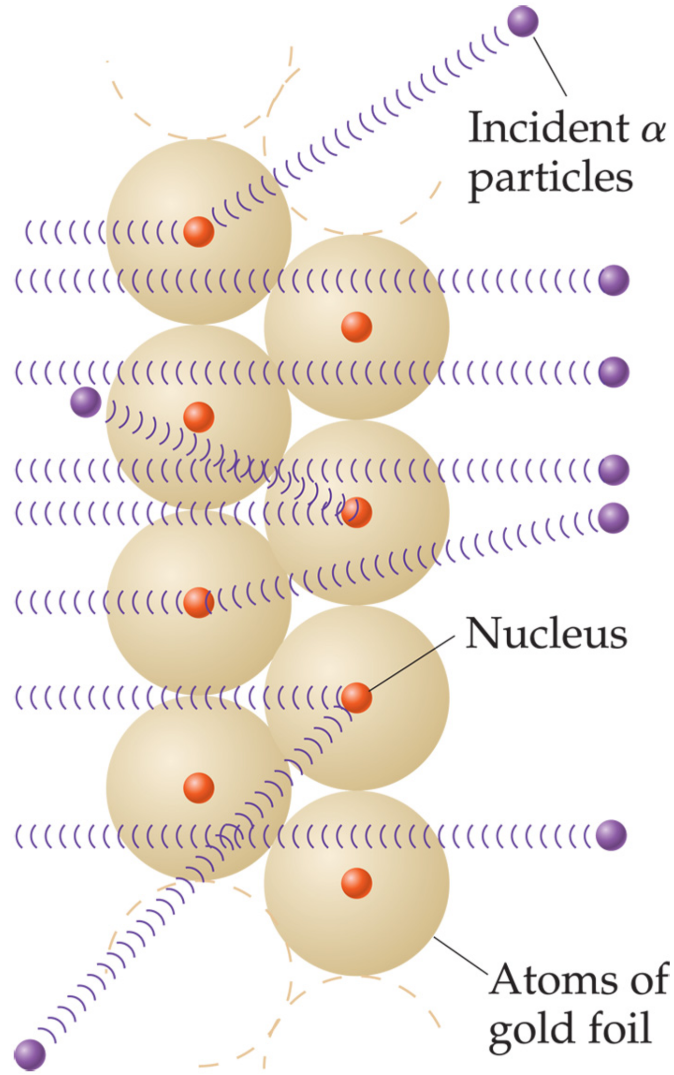
Discovery of the Nucleus
The Gold Foil Experiment



Ernest Rutherford shot α particles at a thin sheet of gold foil and observed the pattern of scatter of the particles.

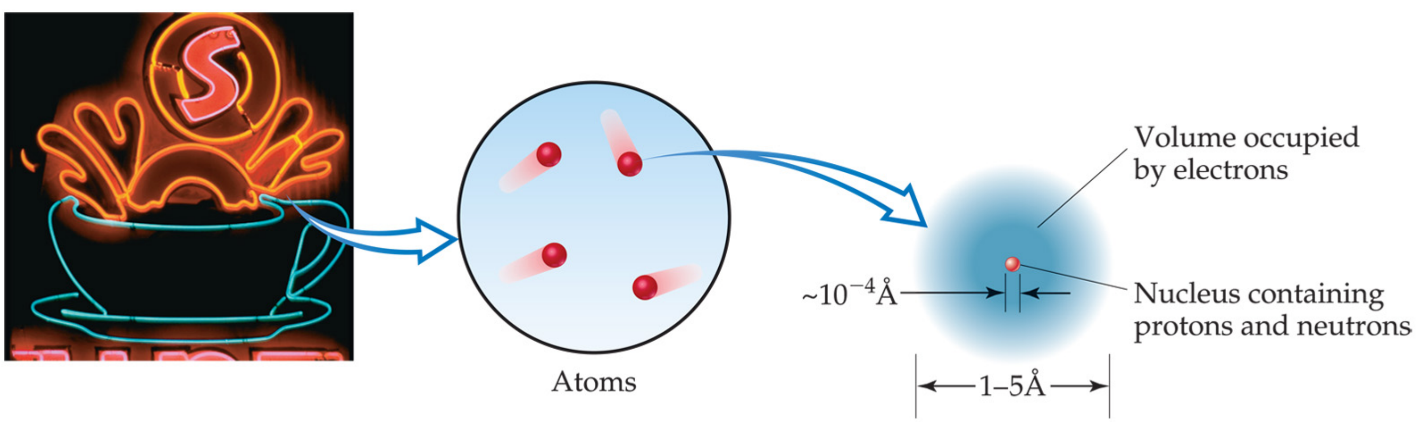
The Nuclear Atom

- Virtually all the particles went straight through
- Most of the atom essentially empty
- A few particles deflected, some straight back.
- A very small part of the atom is very dense, impenetrable.
- The mass must be concentrated.
- The size of nucleus will be proportional to the # of highly scattered versus not.



The Nuclear Atom

- Rutherford postulated a very small, dense nucleus with the negative electrons around the outside of the atom.
- Most of the volume of the atom is empty space.



Other Subatomic Particles

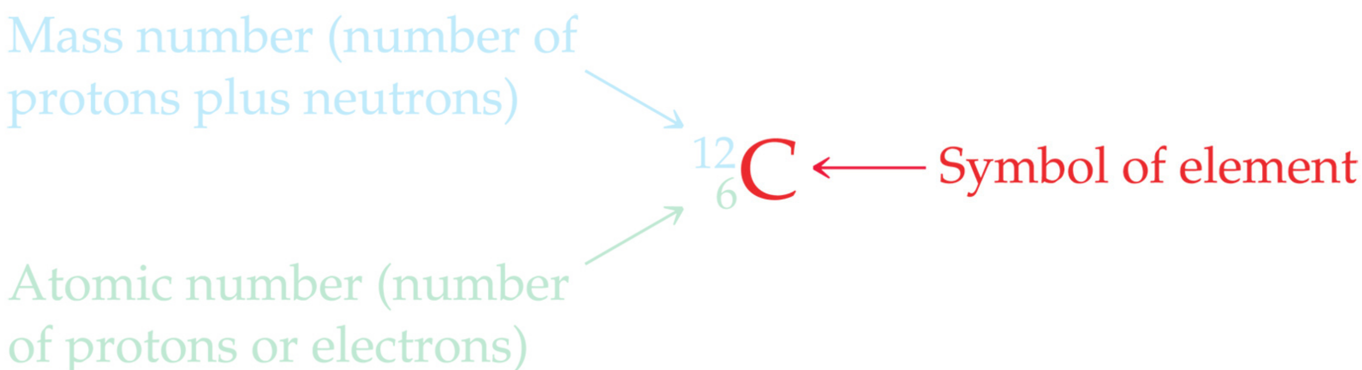
- Protons were discovered by Rutherford in 1919. Have the positive charge in the atom.
- Neutrons were discovered by James Chadwick in 1932. Have mass like proton, but no charge. Why was it harder to discover them?

Subatomic Particles

- Protons and electrons are the only particles that have a charge.
- Protons and neutrons have similar mass.
- The mass of an electron is so small we can often ignore it.

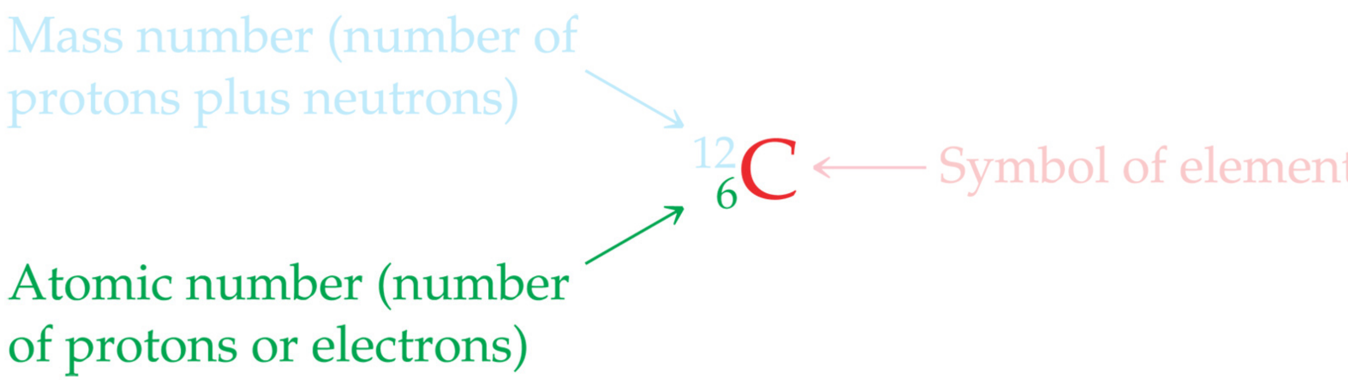
Particle	Charge	Mass (amu)
Proton	Positive (1+)	1.0073
Neutron	None (neutral)	1.0087
Electron	Negative (1−)	5.486×10^{-4}

Symbols of Elements



Elements are symbolized by one or two letters.

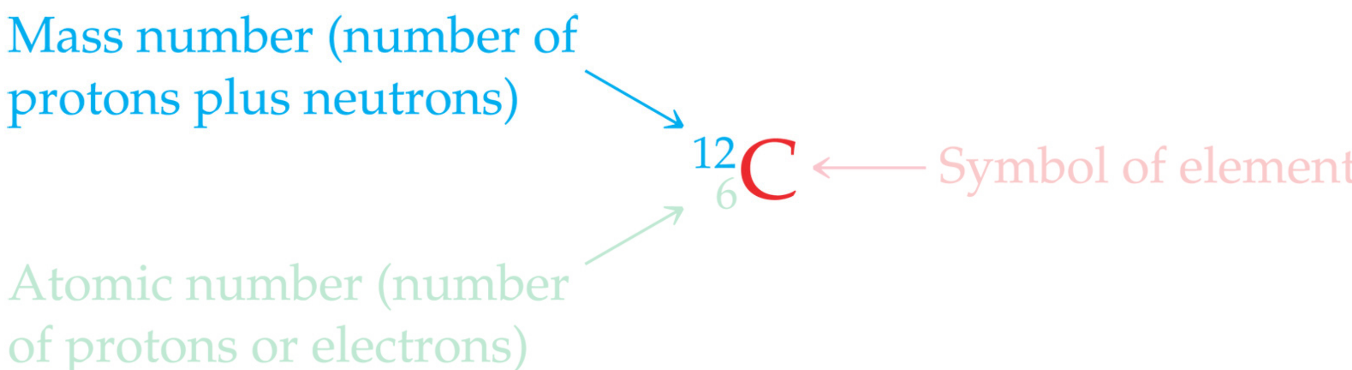
Atomic Number



All atoms of the same element have the same number of protons:

The atomic number (Z)

Atomic Mass



The mass of an atom in atomic mass units (amu) is approximately the total number of protons and neutrons in the atom.

Isotopes:

- Elements are defined by the number of protons.
- Isotopes are atoms of the same element with different masses.
- Isotopes have different numbers of neutrons.

	$^{11}_{6}C$	$^{12}_{6}C$	$^{13}_{6}C$	$^{14}_{6}C$
# Neutrons	5	6	7	8

Average Mass

- Because in the real world all the elements exist as mixtures of isotopes.
- And we measure many many atoms at a time

"Natural abundance"

- Average mass is calculated from the isotopes of an element weighted by their relative abundances.

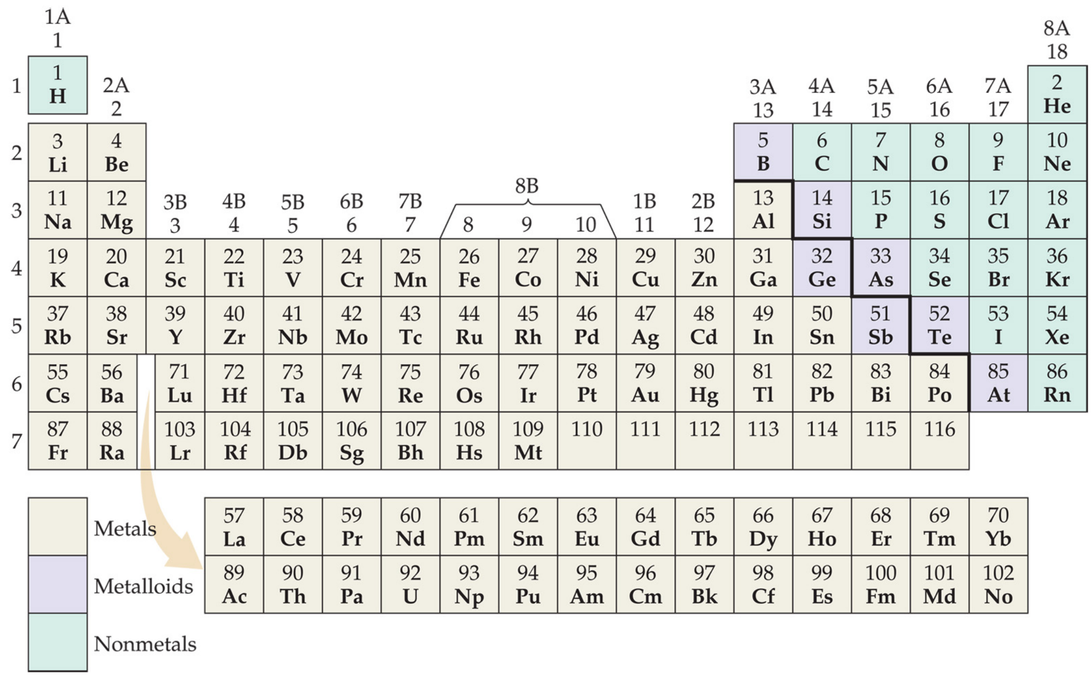
Average mass, example

Isotope	abundance	Atomic mass
^{24}Mg	78.99%	23.98504 amu
^{25}Mg	10.00%	24.98584 amu
^{26}Mg	11.01%	25.98259 amu

Given the above data, what is the average molecular mass of magnesium (Mg)?

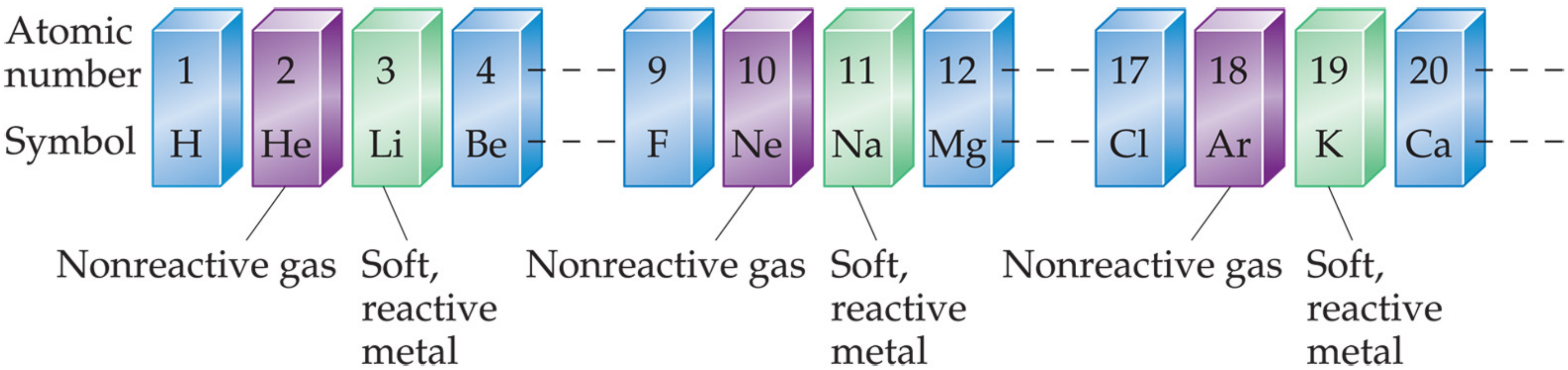
.7899(23.98504)+0.1000(24.98584)+0.1101(25.98259)=
18.95 + 2.499 + 2.861 = 24.31

Periodic Table:



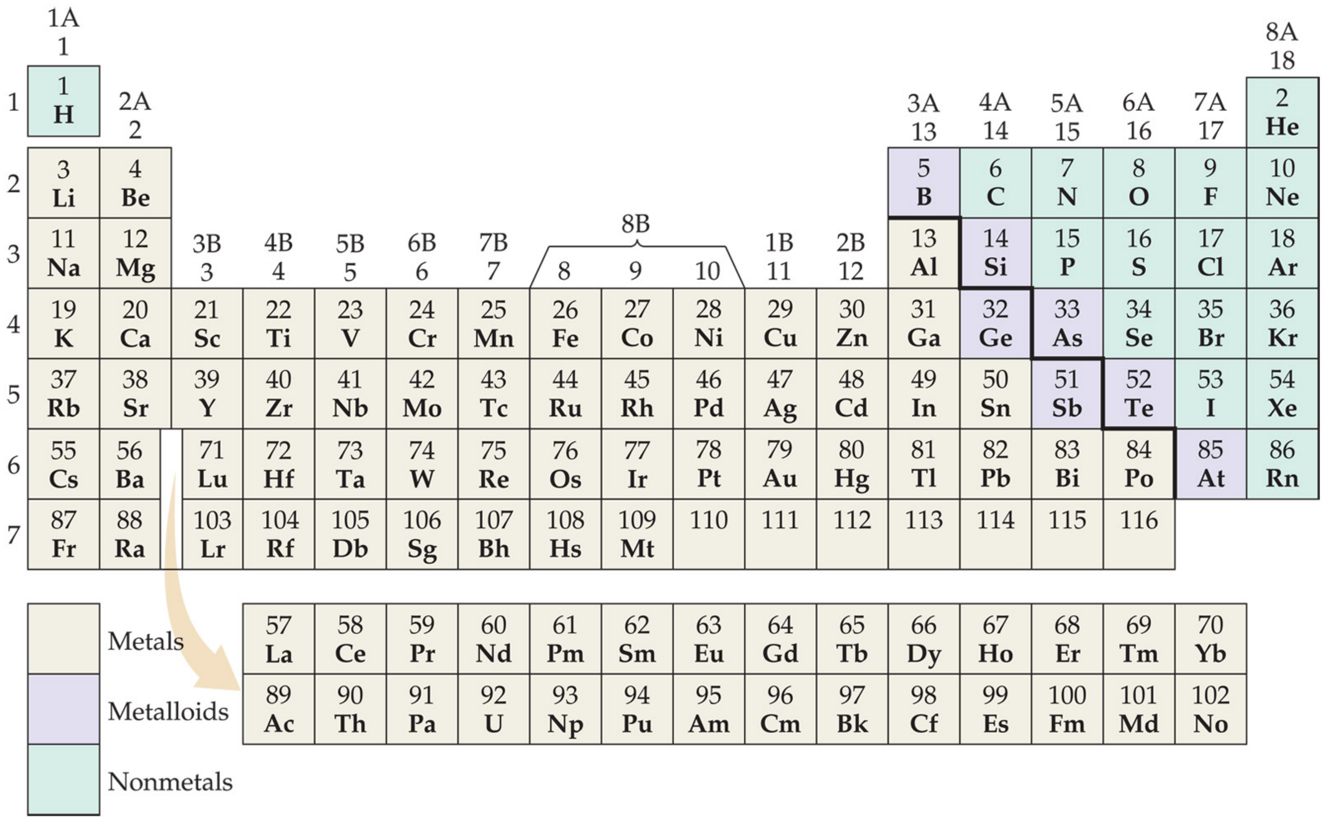
- A systematic catalog of elements.
- Elements are arranged in order of atomic number.
- But why like this?

Periodicity



When one looks at the chemical properties of elements, one notices a repeating pattern of reactivities.

Periodic Table



- The rows on the periodic chart are periods.
- Columns are groups.
- Elements in the same group have similar chemical properties.

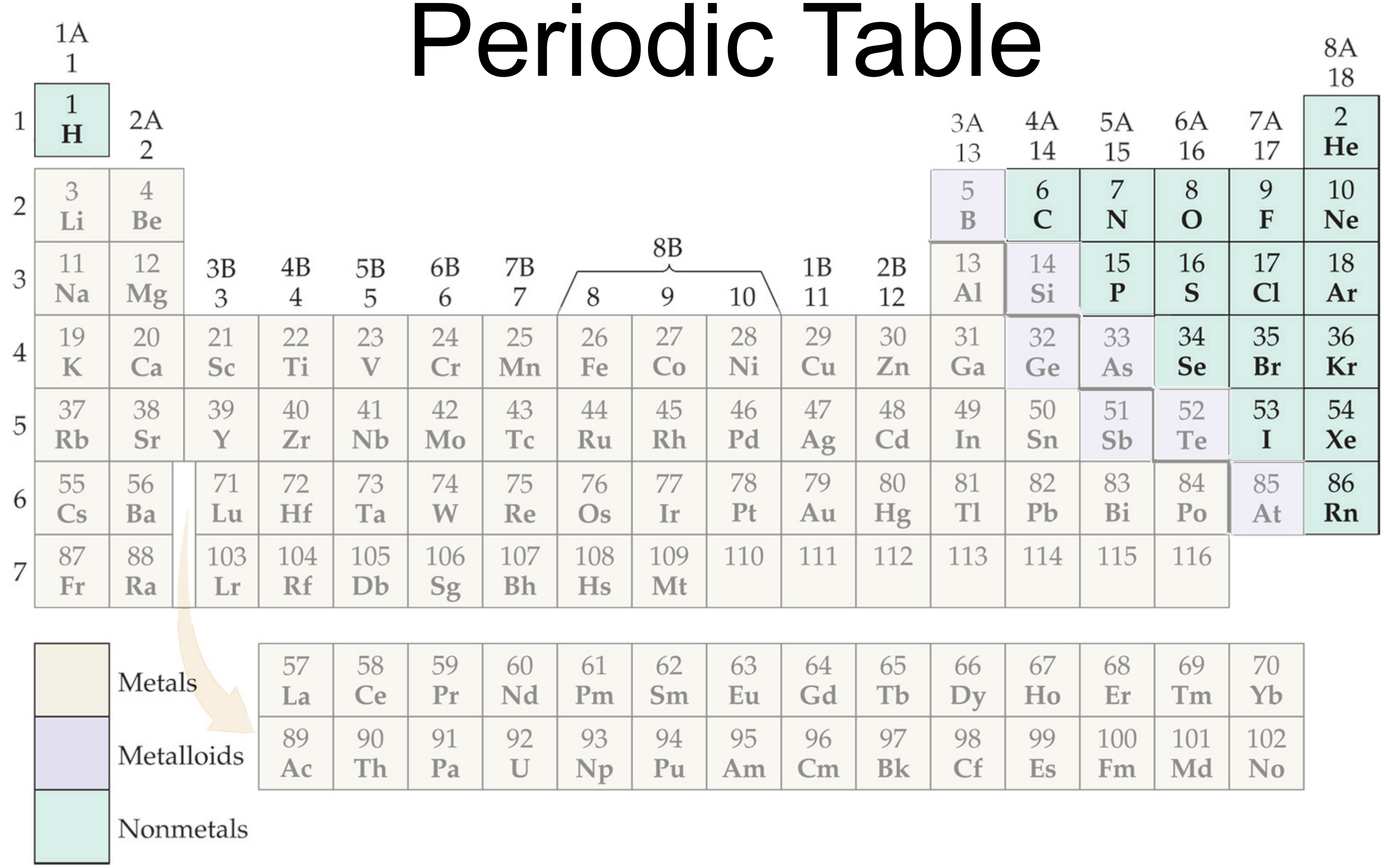
Groups

Group	Name	Elements
1A	Alkali metals	Li, Na, K, Rb, Cs, Fr
2A	Alkaline earth metals	Be, Mg, Ca, Sr, Ba, Ra
6A	Chalcogens	O, S, Se, Te, Po
7A	Halogens	F, Cl, Br, I, At
8A	Noble gases (or rare gases)	He, Ne, Ar, Kr, Xe, Rn

These five groups are known by their names.

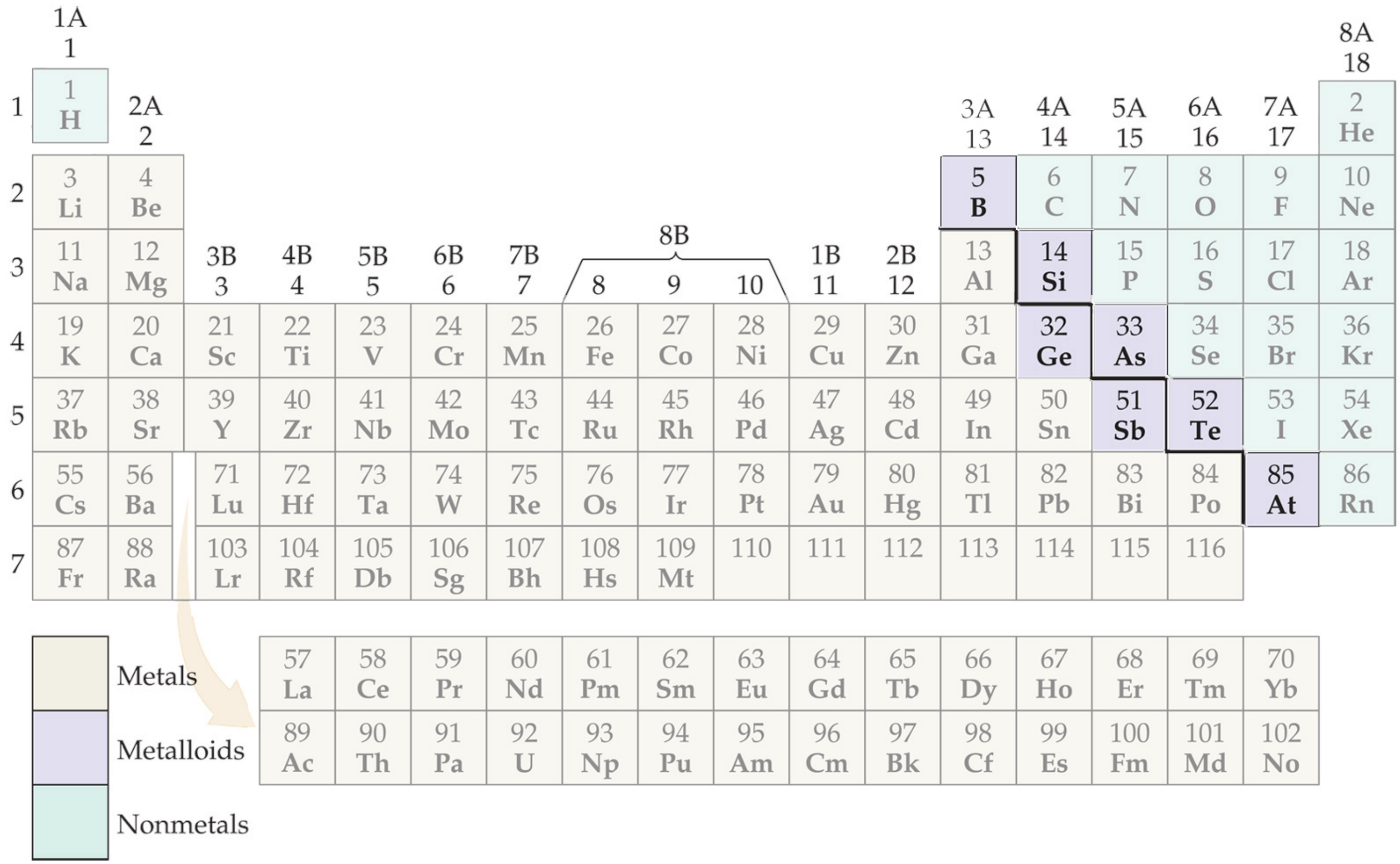
You gotta know these very well.

Periodic Table



Nonmetals are on the upper right-hand corner of the periodic table (with the exception of H).

Periodic Table



Metalloids border the stair-step line (with the exception of Al and Po, which are both metals).

Periodic Table

	1A 1	2A 2	3B 3	4B 4	5B 5	6B 6	7B 7	8B 8	9	10	1B 11	2B 12	3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110	111	112	113	114	115	116		

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No

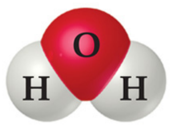
Metals

Metalloids

Nonmetals

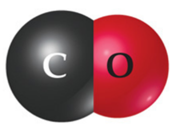
Metals are on the left side of the chart.

Chemical Formulas

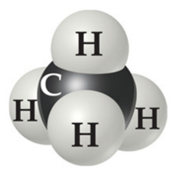


Water, H_2O

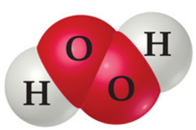
Carbon dioxide, CO_2



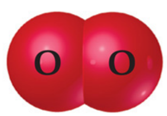
Carbon monoxide, CO



Methane, CH_4



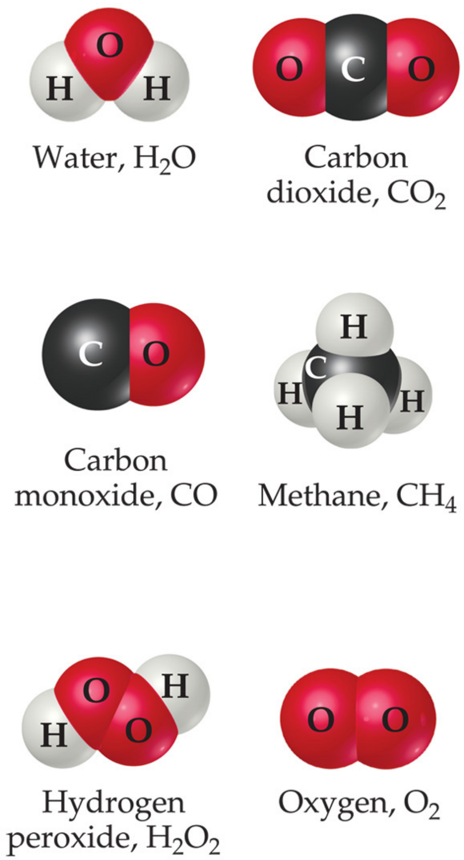
Hydrogen peroxide, H_2O_2



Oxygen, O_2

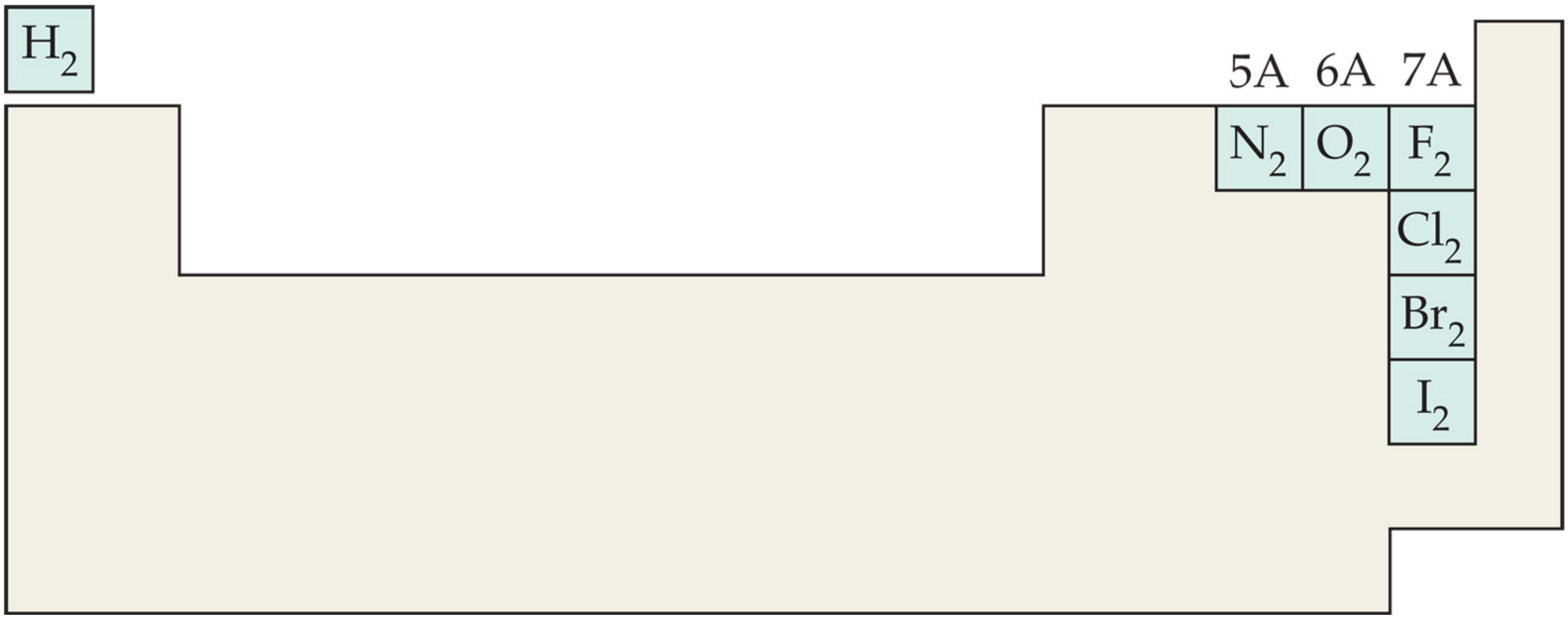
The subscript to the right of the symbol of an element tells the number of atoms of that element in the compound.

Molecular Compounds



Molecular compounds are composed of **molecules** and almost always contain only nonmetals.

Diatomic Molecules



These seven elements occur naturally as molecules containing two atoms.

You should know these guys.

Types of Formulas

- Empirical formulas give the lowest whole-number ratio of atoms of each element in a compound.
- Molecular formulas give the exact number of atoms of each element in a compound.

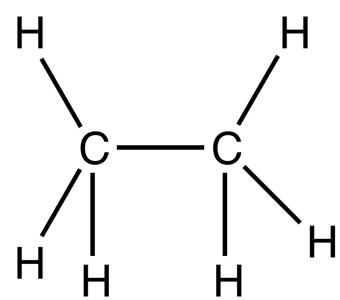
Example: ethane:

Empirical formula: CH_3

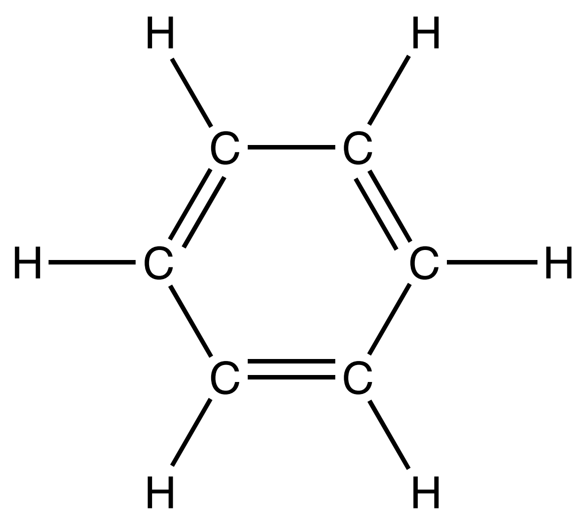
Molecular formula: C_2H_6

Structural Formulas

- Show how the atoms are bound together



Ethane molecular formula C_2H_6
empirical formula: CH_3



Benzene molecular formula C_6H_6
empirical formula: CH

Nomenclature of Binary Compounds

Prefix	*Meaning*
Mono-	*1*
Di-	*2*
Tri-	*3*
Tetra-	*4*
Penta-	*5*
Hexa-	*6*
Hepta-	*7*
Octa-	*8*
Nona-	*9*
Deca-	*10*

- Elements closest to the bottom left of periodic table go 1st.
- A prefix is used to denote the number of atoms of each element in the compound (*mono*- is not used on the first element listed, however.)

Nomenclature of Binary Compounds (two nonmetals)

Prefix	*Meaning*
Mono-	*1*
Di-	*2*
Tri-	*3*
Tetra-	*4*
Penta-	*5*
Hexa-	*6*
Hepta-	*7*
Octa-	*8*
Nona-	*9*
Deca-	*10*

- The ending on the more electronegative element is changed to -*ide*.
  - CO_2: carbon dioxide
  - CCl_4: carbon tetrachloride

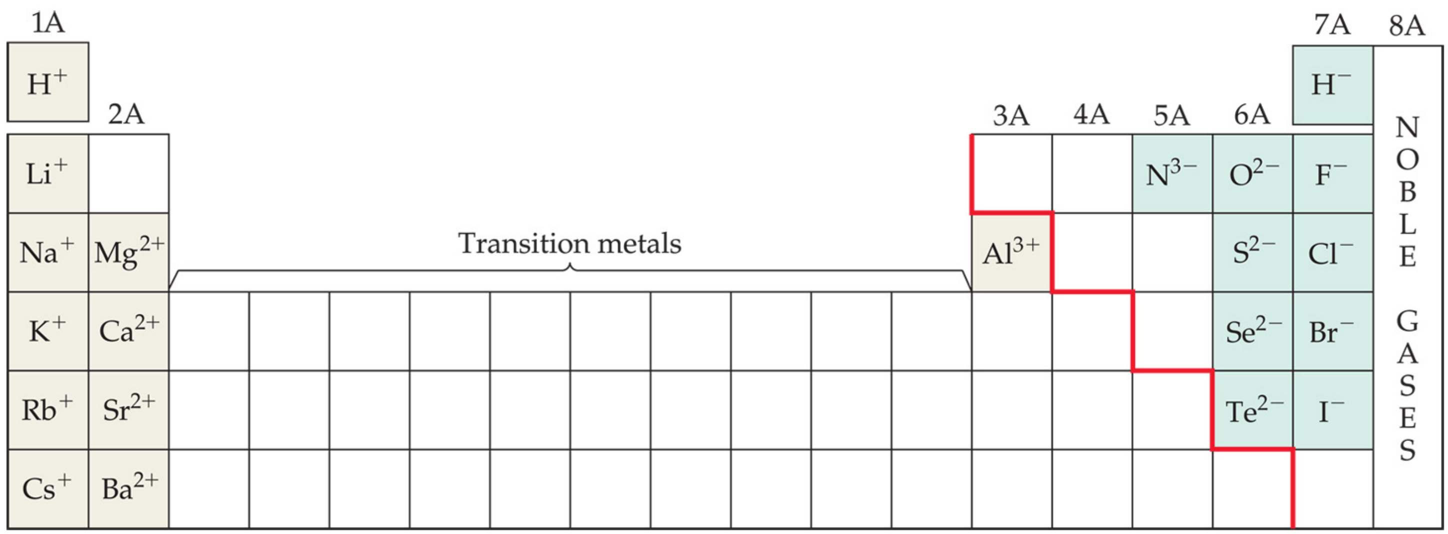
Nomenclature of Binary Compounds

Prefix	*Meaning*
Mono-	1
Di-	2
Tri-	3
Tetra-	4
Penta-	5
Hexa-	6
Hepta-	7
Octa-	8
Nona-	9
Deca-	10

If the prefix ends with *a* or *o* and the name of the element begins with a vowel, the two successive vowels are often merged into one:

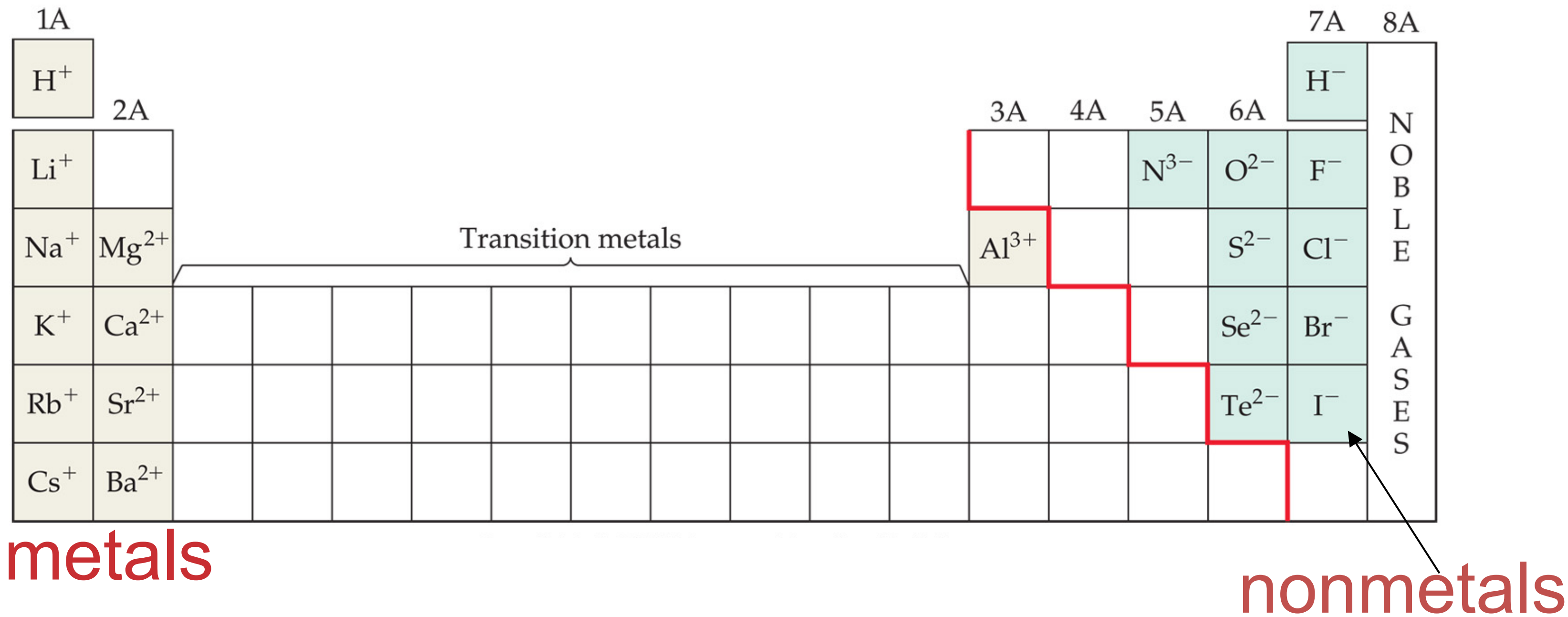
N_2O_5: dinitrogen pentoxide
not: dinitrogen pentaoxide

Ions



- When atoms lose or gain electrons, they become ions. Often they lose or gain electrons to have the same number of electrons as the nearest noble gas.
  - Cations are positive and are formed by elements on the left side of the periodic chart (**metals**).
  - Anions are negative and are formed by elements on the right side of the periodic chart (**nonmetals**).

Mono-atomic ions



- Metals usually become cations (+)
- Nonmetals usually become anions (-)

Ionic compounds

- A metal will give up electrons to a nonmetal forming a cation (+) (the metal), and an anion (-) (the nonmetal).

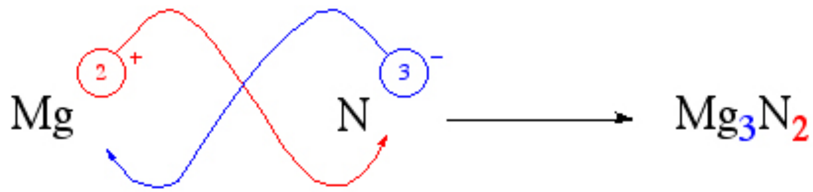
$$Na + Cl \longrightarrow Na^{+} + Cl^{-} \longrightarrow NaCl$$

$$Mg + 2Cl \longrightarrow Mg^{2+} + 2Cl^{-} \longrightarrow MgCl_2$$

Note, everybody gains or loses electrons to be like the nearest noble gas.

Compounds are always electrically neutral!!

Writing Formulas



- Because compounds are electrically neutral, one can determine the formula of a compound this way:
  - The charge on the cation becomes the subscript on the anion.
  - The charge on the anion becomes the subscript on the cation.
  - If these subscripts are not in the lowest whole-number ratio, divide them by the greatest common factor.

Mg^{2+} O^{2-} $\longrightarrow$ MgO Not Mg_2O_2

Common Cations

Charge	Formula	Name	Formula	Name
1+	*H^+	**Hydrogen ion**	*NH_4^+	**Ammonium ion**
	*Li^+	Lithium ion	*Cu^+	Copper(I) or cuprous ion
	*Na^+	**Sodium ion**		
	*K^+	**Potassium ion**		
	*Cs^+	Cesium ion		
	*Ag^+	**Silver ion**		
2+	*Mg^{2+}	**Magnesium ion**	Co^{2+}	Cobalt(II) or cobaltous ion
	*Ca^{2+}	**Calcium ion**	*Cu^{2+}	**Copper(II)** or cupric ion
	*Sr^{2+}	Strontium ion	*Fe^{2+}	**Iron(II)** or ferrous ion
	*Ba^{2+}	Barium ion	Mn^{2+}	Manganese(II) or manganous ion
	*Zn^{2+}	**Zinc ion**	Hg_2^{2+}	Mercury(I) or mercurous ion
	*Cd^{2+}	Cadmium ion	Hg^{2+}	**Mercury(II)** or mercuric ion
			*Ni^{2+}	Nickel(II) or nickelous ion
			*Pb^{2+}	**Lead(II)** or plumbous ion
			Sn^{2+}	Tin(II) or stannous ion
3+	*Al^{3+}	**Aluminum ion**	*Cr^{3+}	Chromium(III) or chromic ion
			*Fe^{3+}	**Iron(III)** or ferric ion

*The most common ions are in boldface.

*You should know these.

Common Anions

Charge	Formula	Name	Formula	Name
1−	*H^-	Hydride ion	*$\mathbf{C_2H_3O_2}^-$	Acetate ion
	*$\mathbf{F}^-$	**Fluoride ion**	*ClO_3^-	Chlorate ion
	*$\mathbf{Cl}^-$	**Chloride ion**	*$\mathbf{ClO_4}^-$	**Perchlorate ion**
	*$\mathbf{Br}^-$	**Bromide ion**	*$\mathbf{NO_3}^-$	**Nitrate ion**
	*$\mathbf{I}^-$	**Iodide ion**	*MnO_4^-	Permanganate ion
	*CN^-	Cyanide ion	*$\mathbf{ClO_2}$	**Chlorite**
	*$\mathbf{OH}^-$	**Hydroxide ion**	*$\mathbf{ClO}$	**Hypochlorite**
2−	*$\mathbf{O}^{2-}$	**Oxide ion**	*$\mathbf{CO_3}^{2-}$	**Carbonate ion**
	*O_2^{2-}	Peroxide ion	*CrO_4^{2-}	Chromate ion
	*$\mathbf{S}^{2-}$	**Sulfide ion**	*$Cr_2O_7^{2-}$	Dichromate ion
			*$\mathbf{SO_4}^{2-}$	**Sulfate ion**
3−	*N^{3-}	Nitride ion	*$\mathbf{PO_4}^{3-}$	**Phosphate ion**

*The most common ions are in boldface.

*You should know these.

More polyatomic anions

SCN^-	Thiocyanate
NO_2^-	Nitrite
SO_3^{-2}	sulfite
HSO_3^-	bisulfite
HSO_4^-	bisulfate
HCO_3^-	bicarbonate
HPO_4^{2-}	Hydrogen phosphate
$H_2PO_4^-$	Dihydrogen phosphate
ClO^-	hypochlorite
ClO_2^-	chlorite

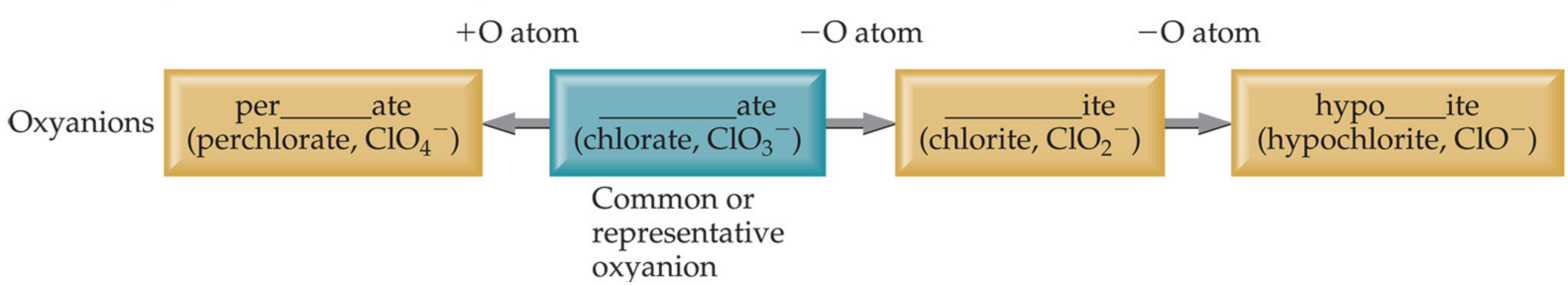
Patterns in Oxyanion Nomenclature

- When there are **only two** oxyanions involving the same element:
  - The one with fewer oxygens ends in -*ite*
    - NO_2^- : nitrite; SO_3^{2-} : sulfite
  - The one with more oxygens ends in -*ate*
    - NO_3^- : nitrate; SO_4^{2-} : sulfate

Patterns in Oxyanion Nomenclature

When there are more than two:

- The one with the fewest oxygens has the prefix *hypo*- and ends in -*ite*
  - ClO^- : hypochlorite
- The one with the second fewest oxygens ends in -*ite*
  - ClO_2^- : chlorite
- The one with the second most oxygens ends in -*ate*
  - ClO_3^- : chlorate
- The one with the most oxygens has the prefix *per*- and ends in -*ate*
  - ClO_4^- : perchlorate



Inorganic Nomenclature

- Write the name of the cation.
- If the anion is an element, change its ending to -*ide*; if the anion is a polyatomic ion, simply write the name of the polyatomic ion.
- If the cation can have more than one possible charge, write the charge as a Roman numeral in parentheses.

Examples
naming inorganic compounds

- Write the name of the cation.
- If the anion is an element, change its ending to -*ide*; if the anion is a polyatomic ion, simply write the name of the polyatomic ion.
- If the cation can have more than one possible charge, write the charge as a Roman numeral in parentheses.

$NaCl$	sodium chloride
NH_4NO_3	ammonium nitrate
$Fe(SO_4)$	Iron(II) sulfate
KCN	potassium cyanide
$RbOH$	Rubidium hydroxide
$LiC_2H_3O_2$	lithium acetate
$NaClO_3$	sodium chlorate
$NaClO_4$	sodium perchlorate
K_2CrO_4	potassium chromate
NaH	Sodium hydride

Examples
naming inorganic compounds

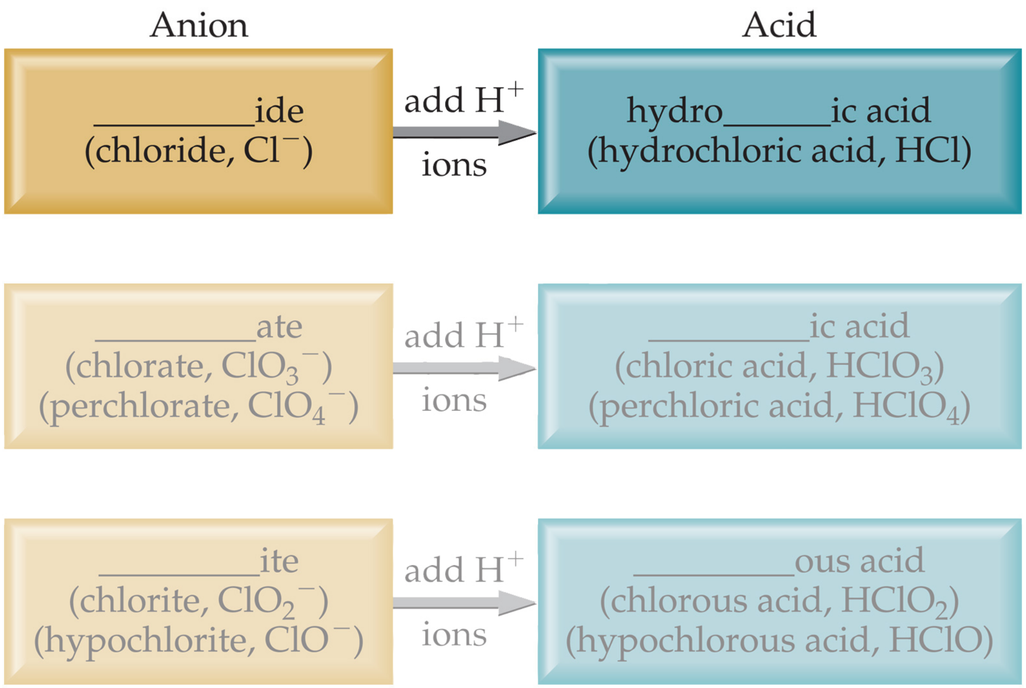
- Write the name of the cation.
- If the anion is an element, change its ending to -*ide*; if the anion is a polyatomic ion, simply write the name of the polyatomic ion.
- If the cation can have more than one possible charge, write the charge as a Roman numeral in parentheses.

potasium permanganate $KMnO_4$
Calcium carbonate $CaCO_3$
Calcium bicarbonate $Ca(HCO_3)_2$
ammonium dichromate $NH_4(Cr_2O_7)$
potassium phosphate K_3PO_4
Lithium oxide Li_2O (O^{2-} is the anion)
sodium peroxide Na_2O_2 (O_2^{2-} is the anion)
Calcium sulfide CaS

Hydrogen

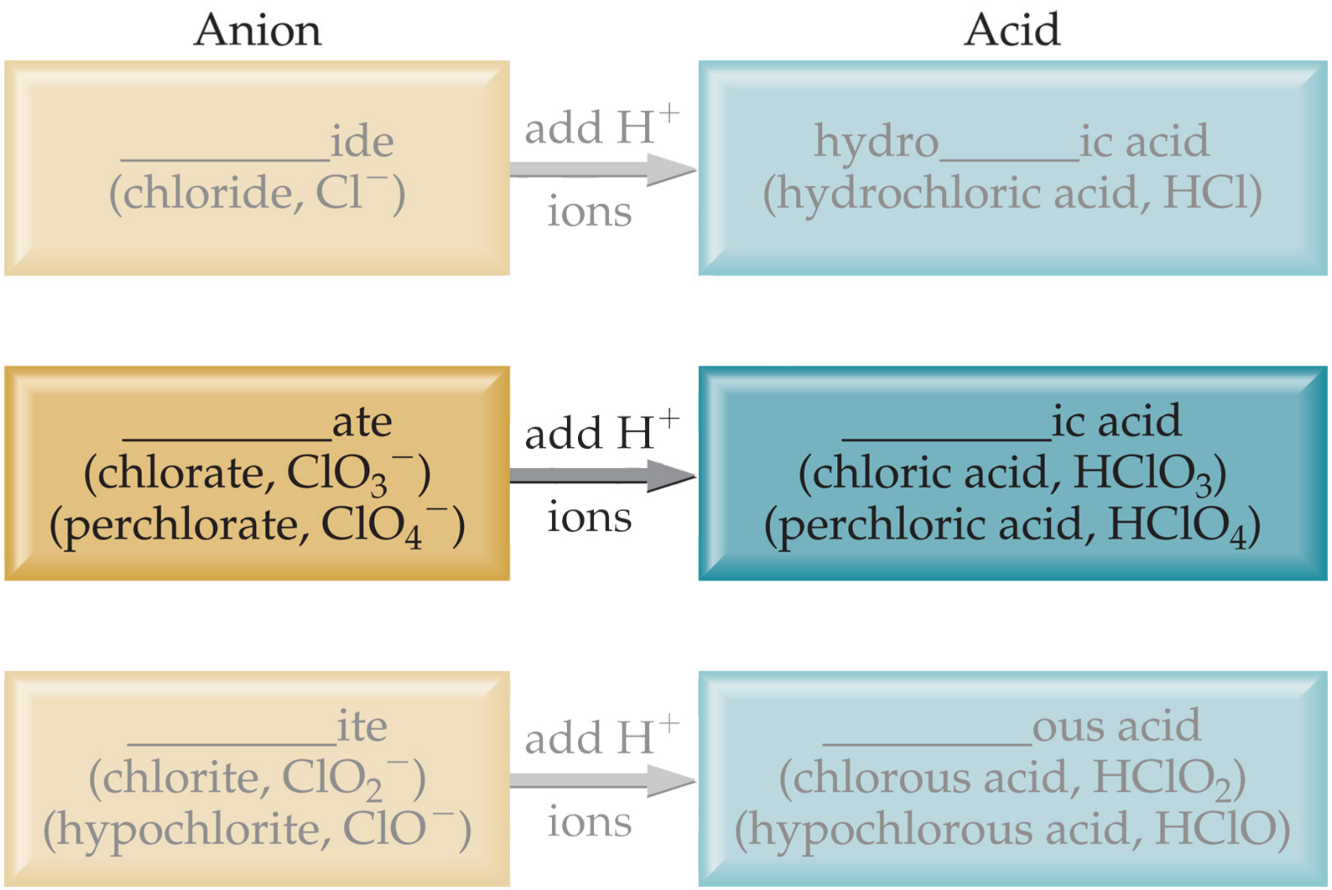
- H can be cation or anion
- H^- hydride
- H^+ (the cation of an inorganic compound) makes an acid, naming different.

Acid Nomenclature



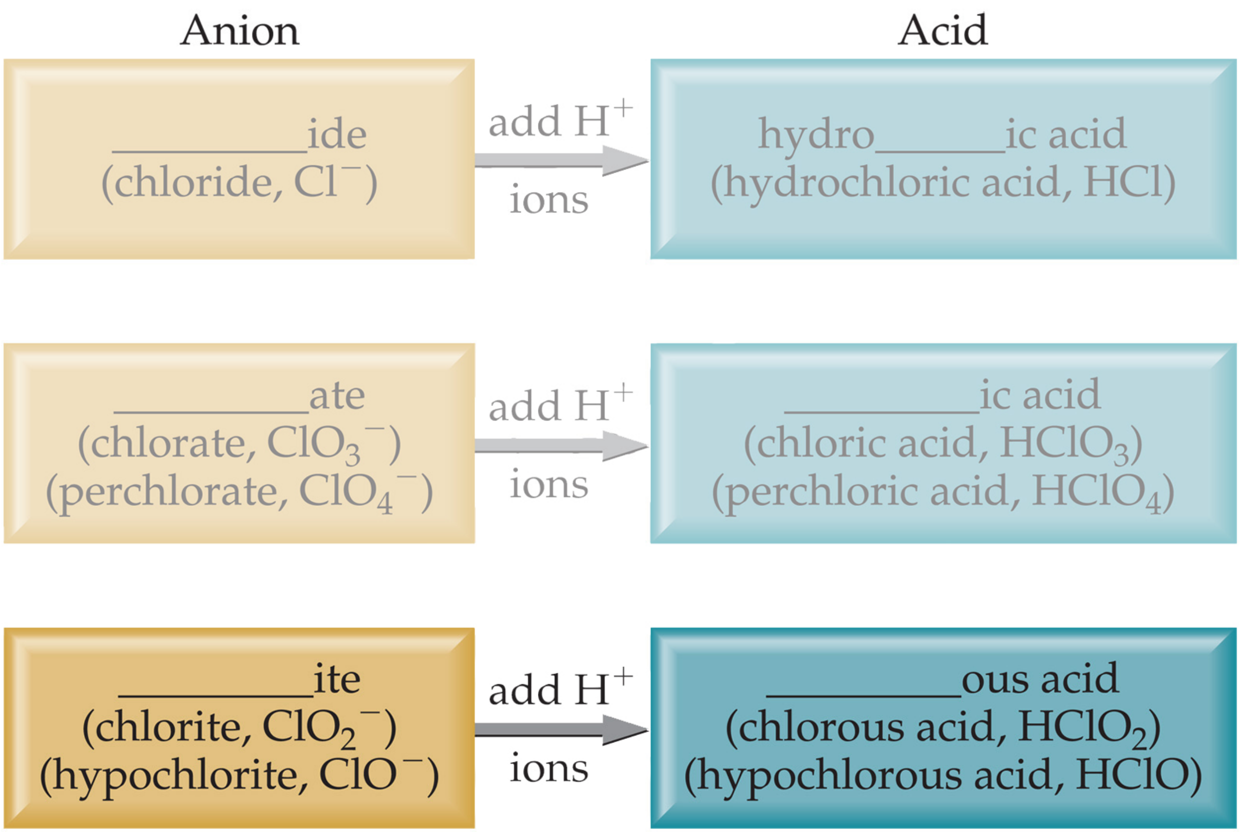
- If the anion in the acid ends in -*ide*, change the ending to -*ic acid* and add the prefix *hydro*- :
  - HCl: hydrochloric acid
  - HBr: hydrobromic acid
  - HI: hydroiodic acid

Acid Nomenclature



- If the anion in the acid ends in -*ate*, change the ending to -*ic acid:*
  - $HClO_3$: chloric acid
  - $HClO_4$: perchloric acid

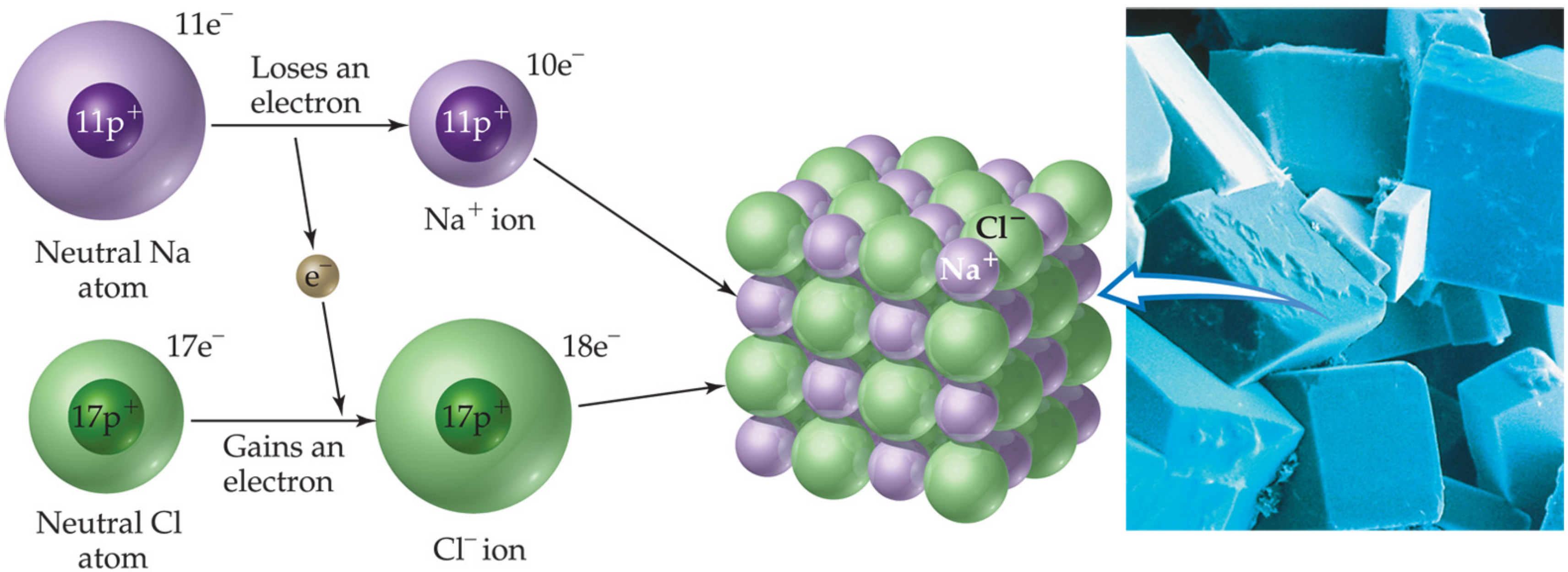
Acid Nomenclature



- If the anion in the acid ends in -*ite*, change the ending to -*ous acid*:
  - HClO: hypochlorous acid
  - $HClO_2$: chlorous acid

Ionic Bonds

Ionic compounds (such as NaCl) are generally formed between metals and nonmetals.



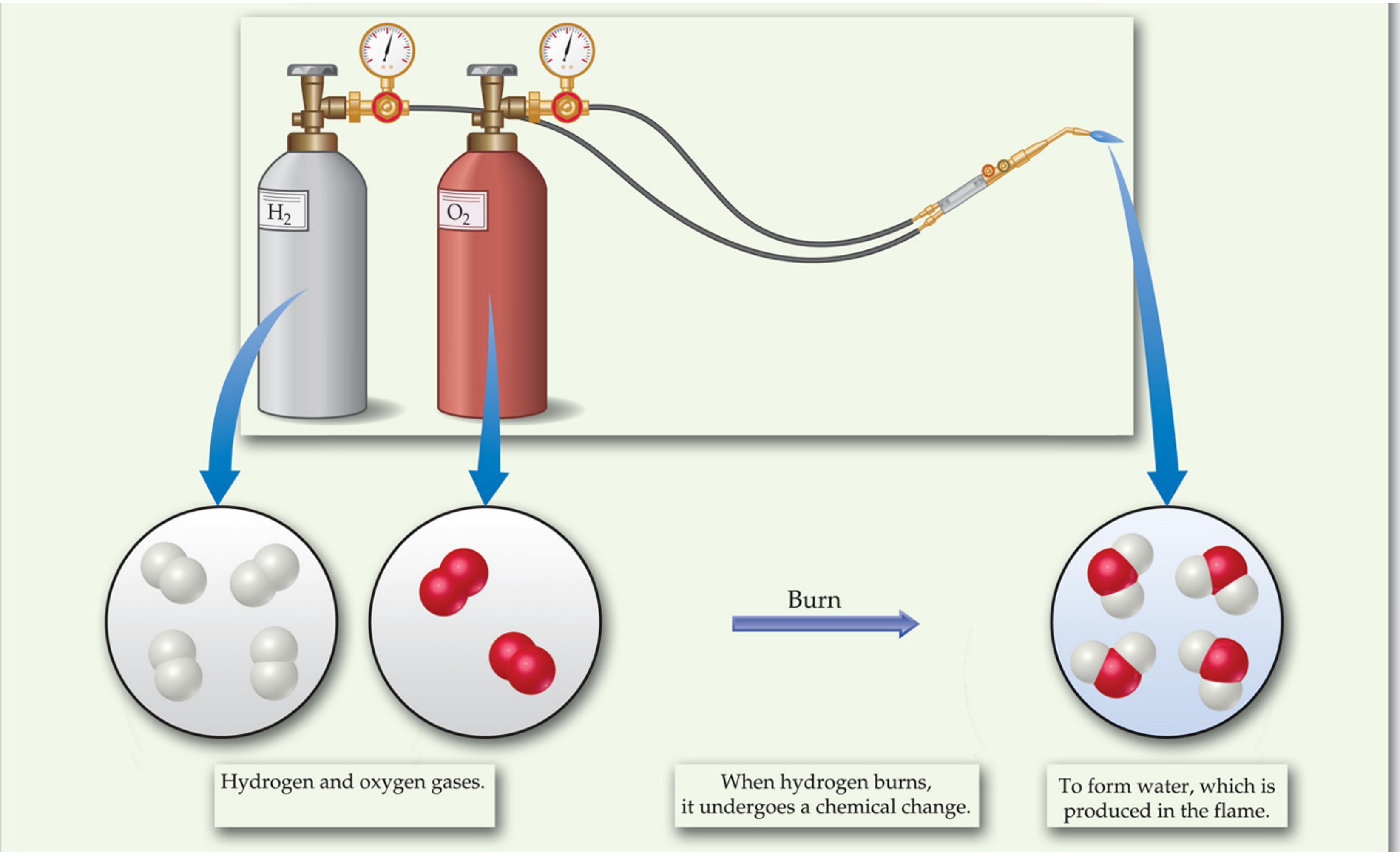
Barking Dog

$2HNO_3 + 2Cu$ ------> $NO + NO_2 + 2Cu^{2+} + 2H^+$

$3\ NO + CS_2$ -> $3/2\ N_2 + CO + SO_2 + 1/8\ S_8$

$4\ NO + CS_2$ -> $2\ N_2 + CO_2 + SO_2 + 1/8\ S_8$

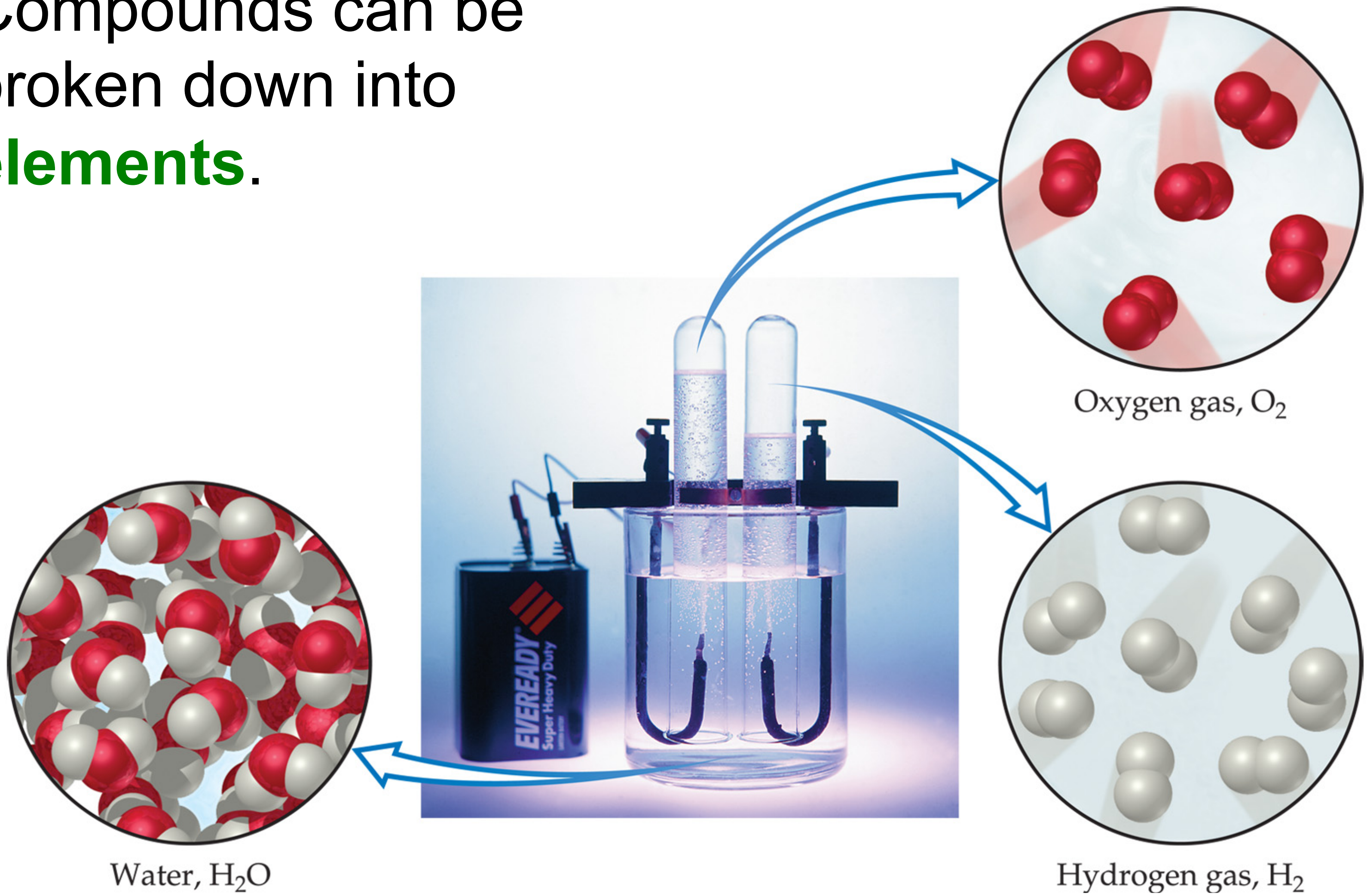
Chemical Reactions



In the course of a chemical reaction, the reacting substances are converted to new substances.

Compounds

Compounds can be broken down into **elements**.



After Lecture 2 you should be able to answer:

questions # 4 and 6
from Examination 1, Spring 2007

General Information

This is a first, introductory course in General Chemistry
No knowledge of Chemistgry is assumed
Fullfills the requirements for many degrees:

NOT meant for: Biochemistry, Chemistry (BS), or Chemical Engineering degrees
A 1.0 in CEM   141 required to go on to CEM 142 and 143

Lectures

Six Lecture series throughout the day. This one is 6-7:20 pm.
Every effort will be made to keep all of these lectures on the same schedule.
Attendance is expected, but not recorded.

General Chemistry Office

General information and assistance is available at the General Chemistry Office
Room 185 (M-F 8-12 noon and 1-5 pm; tel 5-9715 ext 323).
General Chemistry Coordinator Wendy Whitford email: tsuji@chemistry.msu.edu
Undergraduate Program Manager Steve Poulios email: poulios@msu.edu
See these guys for purchasing exam books, scheduling, grades, pretty much any administrative questions. They are very competent!

CEM 141 Joins the new era!

- *CEM 141 web site http://www.cem.msu.edu Go to Course Web Pages (at lower right), then General Chemistry Courses, then CEM 141.*
- *Cemscores web site From any computer on campus, enter cemscores as the url. From computers off-campus, you can access the site through the CEM 141 web site.*
- *CONNECT© problem sets web site Use the access code purchased with the textbook and instructions posted separately to complete your problem sets.*
- *CEM 141 Social Media sites Twitter @MSUCEM141*
- Facebook http://www.facebook.com/MichiganStateUniversityCem141
- **Textbook**
- The text assigned to CEM 141 is Volume 1 of *Chemistry by Hunter & Pollock (ISBN 0078043980 McGraw-Hill). This volume contains only that portion of the regular text that is relevant to CEM 141. It is recommended that you purchase the text bundled with the CONNECT access code (ISBN 0077705092) — reducing the total cost. Note that a CONNECT access code is required, and can be purchased separately (ISBN 0077762304).*
- **Lecture Notes that closely follow each lecture throughout the semester are available at the bookstores (ISBN 9780963047137 $10)**. These notes are intended to make it easier for you to follow the lectures - you should supplement them with your own notes during lecture. **Get them!!**

Recitations

- Your recitation time in on your schedule, the time that is NOT MW 6 pm.
- Limited to about 30 students
- You can directly ask questions and discuss the course material.
- Attendance at the recitation section for which you are enrolled is expected!
- Strive to participate actively!
- relevant exam questions will be presented.
- You will receive credit for your attempts to answer the questions — 5 points for each problem set, maximum 50 points (5% of grade).
- Recitations will start during the second week of the semester (after Labor Day). **DON'T GO THIS WEEK, YOU WILL BE LONELY.**

- **Laboratory**
- The laboratory associated with this class is CEM 161 but concurrent enrollment is *not required (CEM 161 requires separate enrollment).* ***The CEM 161 labs start during the second week of the semester.***
- ***That is everything I know about the lab. I have nothing to do with it.***

Connect on line homework

- **(CONNECT© Homework)**
- Eleven problem sets will be issued this term.
- no make-ups or extensions!
- You can work and study together
- but **you** are responsible for completing your own set of questions
- Due time: Saturday mornings at 8:00 am. Due-dates are noted on the calendar.
- It is essential to do these problems—essential for success.
- *they will contribute 16% to your final grade in the course. You must complete **all** the CONNECT problem sets correctly to obtain the full 160 points.*

Examinations

- Three one-hour examinations (worth 180 points each)
- 7:15 pm on Monday evenings (see calender)
- 1 Final examination at the end of the course (worth 250 points)
- Rooms will be announced later.
- Absence from an examination because of illness must be substantiated by a physician.
- Absence due to extenuating circumstance must be preapproved.
- Alternate exams are offered the Monday mornings or the exam at 6:45 am if you have a scheduling conflict.
- If you cannot take the alternate exam, you will be assigned a score based upon a weighted average of your other two examinations or the final exam, whichever is *lower.*
- *Only one exam may be missed—if a second (or third) exam is missed the grade on that exam will be zero. Students registered with RCPD must start the exams early so that they finish at the scheduled time.*

Grades

- The grade you receive in this course will be calculated from the total number of points out of 1000:
- In-term Exams 180 each Final Exam 250 Problem sets 160 Recitation 50
- You must take the final exam ***at the assigned time to achieve a passing grade in the course***
- *Each CONNECT problem is worth 1 point for a total of 160 points. The deadline for reporting grade discrepancies with CONNECT problem sets and recitation scores on cemscores is the last day of class. The grade scale shown below is fixed, guaranteed, and will not be curved:*

- 1000 – *800 4.0: 739 – 680 3.0: 619 – 560 2.0: 499 – 440 1.0*
- *799 – 740 3.5: 679 – 620 2.5: 559 – 500 1.5: 439 – 0 0.0*

Other help and motivation

- **Help Room**
- Help with the chemistry in CEM 141 is available from the instructors in the Help Room (Room 83 in the basement). The schedule will be posted outside the room. Use the Help Room as much as you like!
- **Learning Resources Center**
- Free tutoring is available at the Learning Resources Center in Bessey Hall and in several residence halls on campus. In each week preceeding an examination, the Learning Resources Center will provide a mock examination on the Tuesday evening and a review on the Thursday evening.
- **General Chemistry Awards**
- Three awards will be given for the top three students enrolled in CEM 141 in the Fall Semester.
- Top student will receive a $500 award;
- Second highest will receive a $300 award
- Third highest will receive a $200 award.
- All awards are funded by the faculty and personnel of the General Chemistry Office.