APES "CHEMISTRY REVIEW" NOTES: NAMES AND FORMULAS

- I. PERIODIC TABLE—schematic presentation of the elements according to their periodic properties, arranged by increasing atomic number
 - A. general layout
 - 1) GROUP—vertical column
 - a) REPRESENTATIVE ELEMENTS—group A elements
 - b) TRANSITION ELEMENTS—group B elements
 - c) INNER TRANTITION ELEMENTS (rare earth metals)-2 "footnotes"
 - 2) PERIOD—horizontal row (1-7)
 - B. metals, nonmetals, and metalloids
 - 1) metals
 - a) most of the periodic table is composed of metals
 - b) metal characteristics: luster, ductility, malleability, conductivity
 - 2) nonmetals
 - a) found in the upper right-hand corner of the chart
 - b) nonmetal characteristics: nonlustrous, poor conductors
 - 3) metalloids (semimetals, semiconductors)—elements having properties of metals and nonmetals (they border the staircase)

THE METALLOIDS: B, Si, Ge, As, Sb, Te, Po

- (Al is classified as "other metal" and At is a nonmetal)
- C. a "staircase" divides the metals from the nonmetals
- D. common elements to know

Ag, Al, Ar, As, Au, B, Ba, Be, Bi, Br, C, Ca, Cl, Co, Cr, Cs, Cu, F, Fe, Fr, H, He, Hg, I, K, Kr, Li, Mg, Mn, N, Na, Ne, Ni, O, P, Pb, Ra, Rb, S, Sb, Si, Sr, Sn, U, W, Zn

II. Atoms and Ions

- A. atomic charge: neutral (net charge of zero) # protons = # electrons
- B. ION—charged atom(s) or group of atoms
 - 1) formed by gain or loss of electrons
 - 2) CATION— a positive ion formed by losing electrons
 - 3) ANION— a negative ion formed by gaining electrons

common ending is —IDE (chloride, bromide, iodide...)

CP ANCations Positive, Anions Negative"Cat People Are Nice"YOU CAN'T LOSE OR GAIN PROTONS TO FORM AN ION!

4) an ion has different properties than its element (Na atom vs. Na⁺ ion)

III. Compounds

A. COMPOUND (cmpd.)—a substance formed from more than one element

- B. MOLECULE—a group of atoms with no net charge
- C. two general types of cmpds.
 - 1) MOLECULAR COMPOUND—composed of molecules
 - usually liquids or gases at room temp.
 - usually have a low melting point (m.p.) and boiling point (b.p.)
 - composed of nonmetals... like CO₂
 - 2) IONIC COMPOUNDS—composed of positive/negative ions (formula units)
 - usually crystalline solids at room temp.

- usually have a high melting point (m.p.) and boiling point (b.p.)
- composed of metals and nonmetal... like NaCl

THE SEVEN DIATOMIC MOLECULES: H_2 F_2 O_2 N_2 Cl_2 Br_2 I_2

IV. Chemical formulas

- A. CHEMICAL FORMULA
 - 1) symbols representing the composition of the smallest unit of a substance
 - 2) shows which elements are present and how many there are
 - H_2SO_4 hydrogen, sulfur, oxygen 7 atoms total
- B. MOLECULAR FORMULA-symbols representing the composition of a molecule
- C. FORMULA UNIT— the lowest whole-number ratio if ions in an ionic compound It is improper to use the term "molecule" to describe an ionic compound. Ionic compounds occur in repeating *units* in their crystals.

D. number codes

- 1) SUBSCRIPT—a number written slightly below the symbol Br_2
- 2) SUPERSCRIPT—a number written slightly above the symbol Sr^{2+}
- V. Ionic Charges of the Elements

A. pattern

Group IA	IIA	IIIA	IVA	VA*	VIA*	VIIA*	0 (VIIIA)
1+	2+	3+	Х	3-	2-	1-	none

x most of Group IVA don't usually form ions * when applicable

- B. metals form cations (+) nonmetals form anions (--)
 - C. multiple charges (transition metals)
 - 1) Stock system uses number clues
 - 2) Classical (Latin root) system

LOWER CHARGED ION: suffix "–OUS" Cu^+ = cuprous ion HIGHER CHARGED ION: suffix "–IC" Cu^{2+} = cupric ion

ION FORMULA	STOCK NAME	CLASSICAL NAME
Cu^+	copper(I) ion	cuprous ion
Cu ²⁺	copper(II) ion	cupric ion
Fe ²⁺	iron(II) ion	ferrous ion
Fe ³⁺	iron(III) ion	ferric ion
$\begin{array}{c} Cu^{2+} \\ Fe^{2+} \\ Fe^{3+} \\ Hg_2^{2+} \\ Hg_2^{2+} \\ Pb^{2+} \\ Pb^{4+} \\ \end{array}$	mercury(I) ion	mercurous ion
$\mathrm{Hg_2}^{2+}$	mercury(II) ion	mercuric ion
Pb^{2+}	lead(II) ion	plumbous ion
Pb ⁴⁺	lead(IV) ion	plumbic ion
Sn ²⁺	tin(II) ion	stannous ion
Sn^{4+} Cr^{2+} Cr^{3+}	tin(IV) ion	stannic ion
Cr^{2+}	chromium(II) ion	chromous ion
Cr^{3+}	chromium(III) ion	chromic ion
Mn^{2+}	manganese(II) ion	manganous ion
Mn ³⁺	manganese(III) ion	manganic ion
Co^{2+} Co^{3+}	cobalt(II) ion	cobaltous ion
Co ³⁺	cobalt(III) ion	cobaltic ion

3) one-charge transition metal ions: Ag^+ , Cd^{2+} , Zn^{2+}

VI. Polyatomic ions: a group of charged atoms; most end in -ATE or -ITE

VII. BINARY COMPOUNDS: BINARY IONIC & BINARY MOLECULAR

- A. BINARY CMPD.—composed of two elements
 - 1) compound composed of monatomic ions
 - 2) net charge must be zero
- B. crisscross formula method
 - 1) write the symbols of the two ions next to each other
 - 2) write the charges as superscripts
 - 3) balance the formula by crisscrossing the numbers

C. BINARY IONIC CMPDS.-metal cation / nonmetal anion combination

- 1) name the cation first, then the anion (-*IDE* ending)
- 2) use Roman numerals if/when needed for the cation
- 3) examples:
 - CaBr2 calcium bromide; KI potassium iodide; FeCl3 iron(III) chloride
- D. BINARY MOLECULAR CMPDS.-nonmetal / nonmetal combination
 - 1) two nonmetallic elements
 - 2) no ionic charges involved
 - 3) ending in -IDE
 - 4) prefixes used in naming:
 - MONO-, DI-, TRI-, TETRA-, PENTA-, HEXA-, HEPTA-, OCTA-, NONA-, DECA-(mono- is not used on the first element)
 - 5) examples:
 - CCl₄ carbon tetrachloride; BF₃ boron trifluoride; CO carbon monoxide

VIII. Ternary Ionic Compounds

- A. TERNARY CMPD.-compound made up of three different elements
- B. crisscross formula method for ions

C. examples:

Na₂SO₄ sodium sulfate; KMnO₄ potassium permanganate; Fe(OH)₃ iron(III) hydroxide

IX. Common Acids

ACIDS—compounds that donate H+ ions in solution $HX \rightarrow H^+ + X^$ acetic acid HC₂H₃O₂ or CH₃COOH carbonic acid H₂CO₃ hydrochloric acid HCl nitric acid HNO₃ phosphoric acid H₃PO₄ sulfuric acid H₂SO₄