

Chapter 3

- ① Electronic Configurations of Elements
- ② Electronic Configurations of Ions
- ③ Ionic Compounds
 - Formation of - how to write them
 - Nomenclature - how to name them

3 Types of ionic Compounds

- * - Main group cations w/ main group anions
IA → IIIA VIA - VIIA
- Transition Metal Cations w/ main group anions
(variable charge states)
- main group & Transition metal cations w/
polyatomic anions (many atom anions)

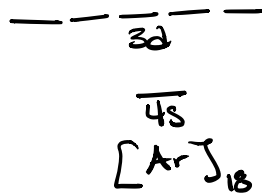
Goals

- * Show how to properly write & name
- * Show how to memorize by association

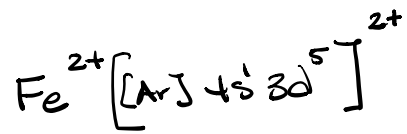
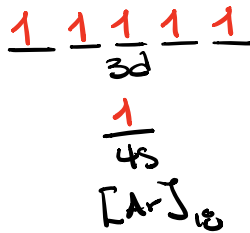


Case #2 Transition Metals w/ main Group anions

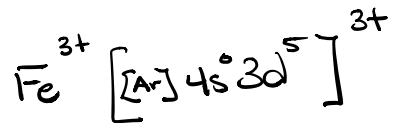
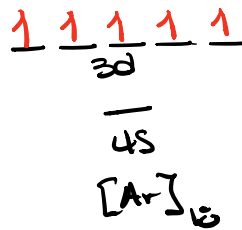
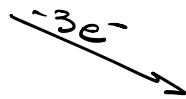
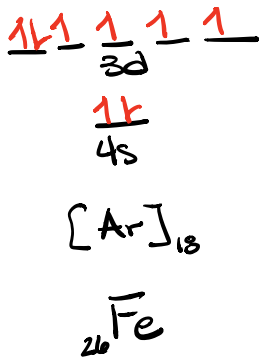
period 4 4s 3d orbitals



many stable configurations resulting from the loss of $1e^-$, $2e^-$, $3e^-$, $4e^-$... $7e^-$

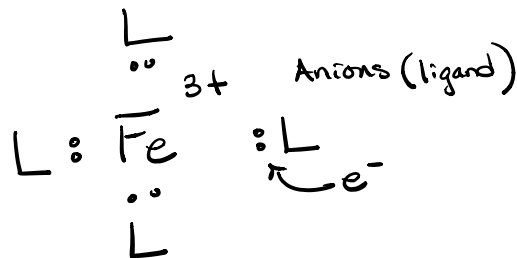


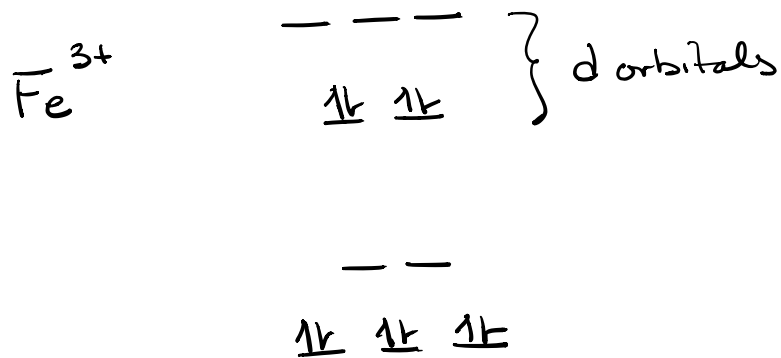
$$\begin{array}{r} 26p = 26+ \\ 24e^- = 24- \\ \hline 2+ \end{array}$$



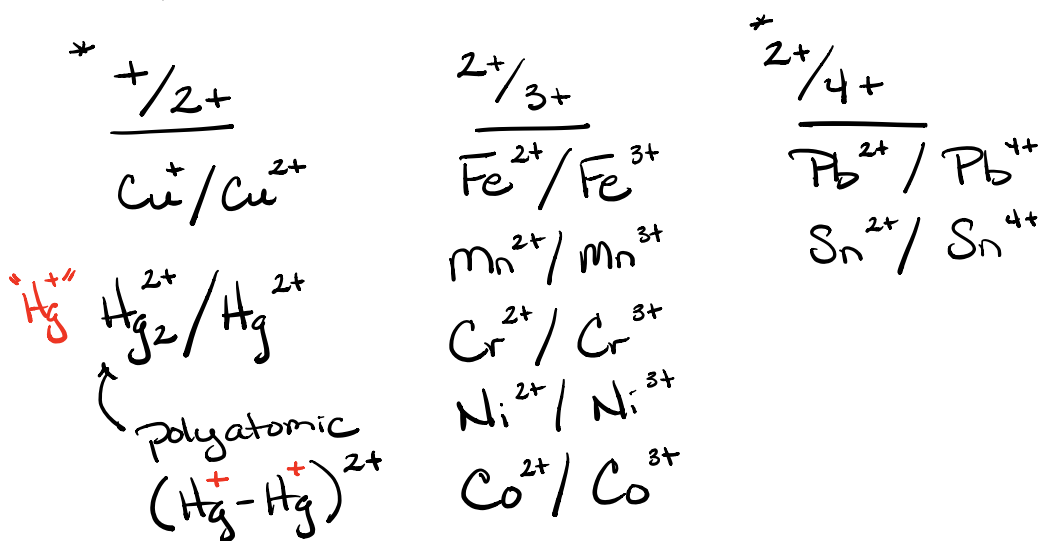
$$\begin{array}{r} 26p = 26+ \\ 23e^- = 23- \\ \hline 3+ \end{array}$$

$$\begin{array}{r} 26p^+ = 26+ \\ 26e^- = 26- \\ \hline 0 \end{array}$$

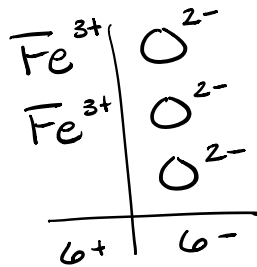
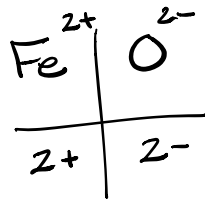




Most Common Charge States



Transition Metals w/ main group anions



Two possible
Compounds formed
w/ oxygen

Completely different compounds w/ different
physical & chemical properties

⇒ Require Different Names

⇒ Two naming systems

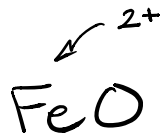
- Roman numerals to denote the
charge on cation



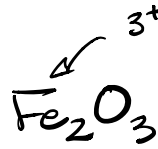
- Used roots & suffix to denote
charge state



* you need to know
what charge state
is possible.

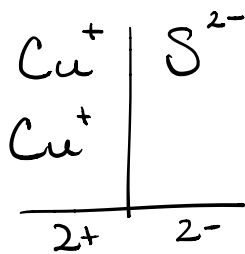


Iron (II) Oxide
or
Ferrous Oxide



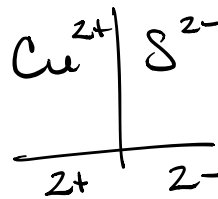
Iron (III) oxide
Ferric Oxide

Copper (I) Sulfide



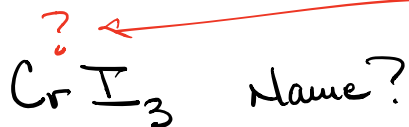
Cuprous Sulfide
↑
Low charge

Copper (II) Sulfide

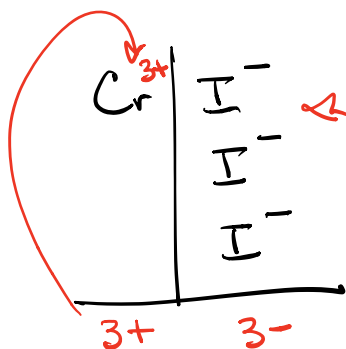


Cupric Sulfide
↑
High charge

Examples of working Backwards from the formula to name



Before I can name it I need to know the charge on Cr
 Cr variable
 \Rightarrow Iodide fixed

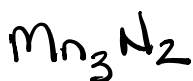


work backwards from fixed charge state of anion to find cation

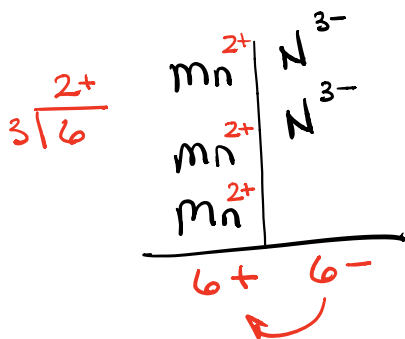
Chromium(III) iodide

or

Chromic iodide



Manganese(II) Nitride
 or
 Manganous Nitride



Take total positive charges & equally distributing divide total charge by # of ions

1 1A H Hydrogen 1.008	2 2A He Helium 4.003											13 3A B Boron 10.81	14 4A C Carbon 12.01	15 5A N Nitrogen 14.01	16 6A O Oxygen 16.00	17 7A F Fluorine 19.00	18 8A Ne Neon 20.18
3 Li Lithium 6.941	4 Be Beryllium 9.012	Variable										5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18
11 Na Sodium 22.99	12 Mg Magnesium 24.30	3 3B Al Aluminum 26.98	4 4B Si Silicon 28.09	5 5B P Phosphorus 30.97	6 6B S Sulfur 32.07	7 7B Cl Chlorine 35.45	8 8B Ar Argon 39.95	9 9B K Potassium 39.10	10 10B Ca Calcium 40.08	11 1B Sc Scandium 44.96	12 2B Ti Titanium 47.87	13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.07	17 Cl Chlorine 35.45	18 Ar Argon 39.95
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.87	23 V Vanadium 50.94	24 Cr Chromium 52.00	25 Mn Manganese 54.94	26 Fe Iron 55.84	27 Co Cobalt 58.93	28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.39	31 Ga Gallium 69.72	32 Ge Germanium 72.61	33 As Arsenic 74.92	34 Se Selenium 78.96	35 Br Bromine 79.90	36 Kr Krypton 83.80
37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.95	43 Tc Technetium 97.91	44 Ru Ruthenium 101.1	45 Rh Rhodium 102.9	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurium 127.6	53 I Iodine 126.9	54 Xe Xenon 131.3
55 Cs Cesium 132.9	56 Ba Barium 137.3	Lanthanides															
87 Fr Francium 223	88 Ra Radium 226																
		72 Hf Hafnium 178.5	73 Ta Tantalum 180.9	74 W Tungsten 183.8	75 Re Rhenium 186.2	76 Os Osmium 190.2	77 Ir Iridium 192.2	78 Pt Platinum 195.1	79 Au Gold 197.0	80 Hg Mercury 200.6	81 Tl Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 209.0	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222	
		104 Rf Rutherfordium 261	105 Db Dubnium 262	106 Sg Seaborgium 263	107 Bh Bohrium 262	108 Hs Hassium 265	109 Mt Meitnerium 266	110 Ds Darmstadtium 269	111 Rg Roentgenium 272	112 Cn Copernicium 277	113 Nh Nihonium 289	114 Fl Flerovium 289	115 Mc Moscovium 289	116 Lv Livermorium 289	117 Ts Tennessine 289	118 Og Oganesson 289	
		57 La Lanthanum 138.9	58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium 145	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.2	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0	71 Lu Lutetium 175.0	
		89 Ac Actinium 227	90 Th Thorium 232.0	91 Pa Protactinium 231.0	92 U Uranium 238.0	93 Np Neptunium 237	94 Pu Plutonium 244	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 247	98 Cf Californium 251	99 Es Einsteinium 252	100 Fm Fermium 257	101 Md Mendelevium 258	102 No Nobelium 259	103 Lr Lawrencium 262	

Lanthanides

Actinides

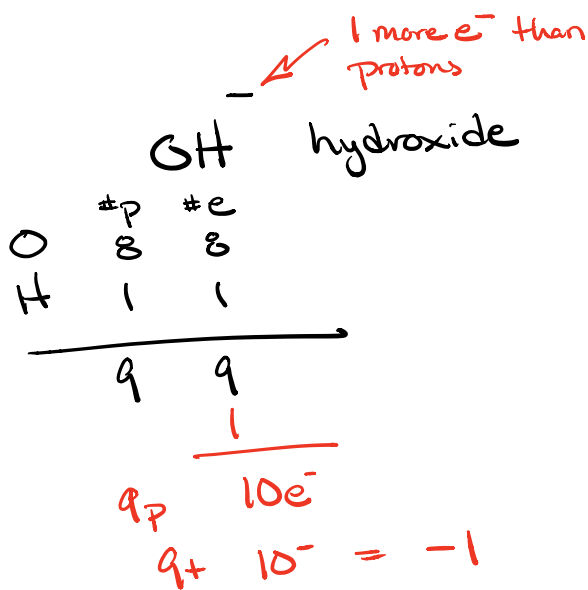
Polyatomic Ions

Poly = "many"

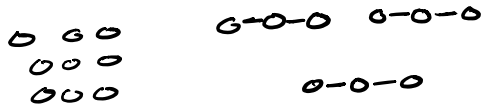
atomic = atom

→ many atom ion

→ Has more or less e^- than total # of protons



Memorization



- families (Parent)
 - Proton family
 - one-off's
- } Related

The Chlorine family

Cl Chlorine

Cl⁻ Chloride

Compounds w/ oxygen

same charge as monatomic ion
Prefix Root Suffix = # of Oxygen
ClO₄⁻ per Chlorate per = 1 more than -ate

ClO₃⁻ Chlorate ate = more oxygen

ClO₂⁻ Chlorite ite = less oxygen

ClO⁻ hypo Chlorite hypo = 1 less than -ite

Br Bromine

Br⁻ Bromide

BrO₄⁻ perbromate

BrO₃⁻ bromate

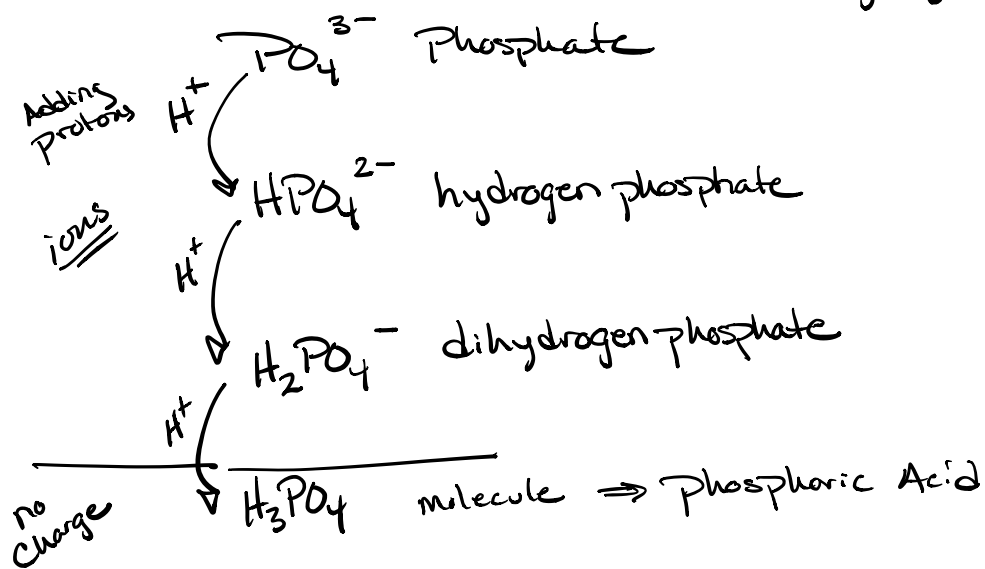
BrO₂⁻ bromite

BrO⁻ hypobromite

Main families

<u>Cl</u>	<u>S</u>	<u>P</u>	<u>N</u>
Cl^- Chloride	S^{2-} Sulfide	P^{3-} Phosphide	N^{3-} Nitride
ClO_4^- perchlorate	SO_4^{2-} Sulfate	PO_4^{3-} Phosphate	NO_3^- Nitrate
ClO_3^- chlorate	SO_3^{2-} Sulfite	PO_3^{3-} Phosphite	NO_2^- Nitrite
ClO_2^- chlorite			
ClO^- hypochlorite			

Proton family

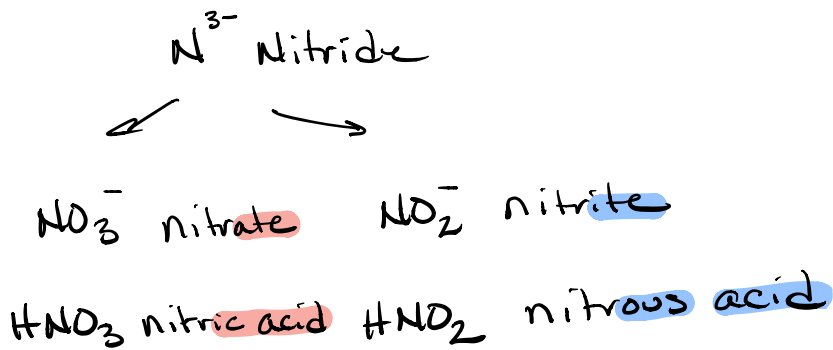
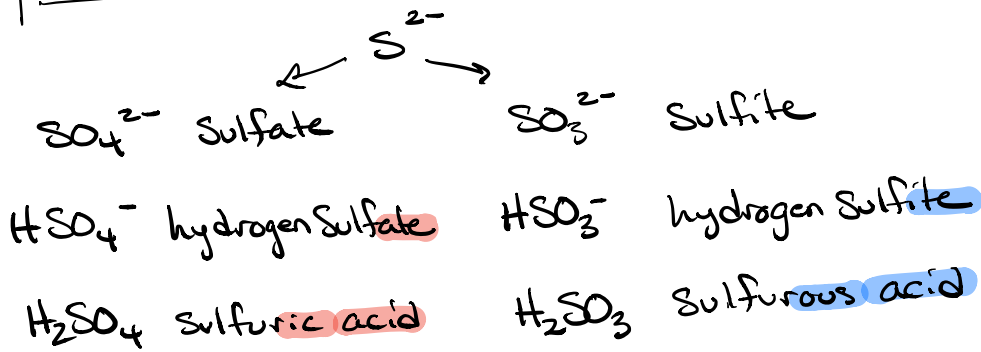
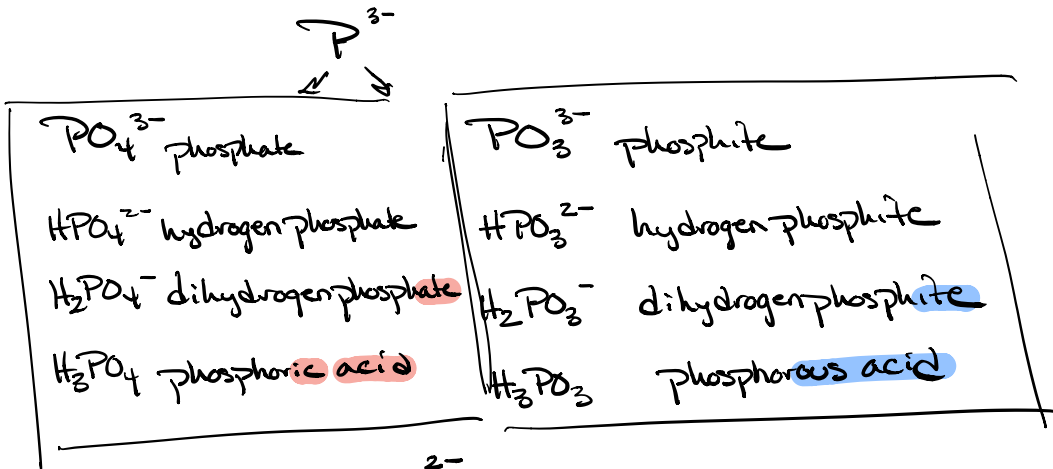


Hydrogen H^+ = "proton"

P^+
 O^-

Molecule = neutral (many atoms)

Ion = charged



One-off Poly atomic ions

OH^- hydroxide

CN^- cyanide

MnO_4^- permanganate

SCN^- thiocyanate

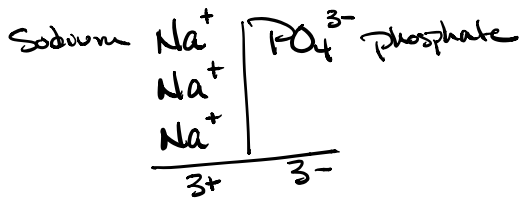
$\text{C}_2\text{H}_3\text{O}_2^-$ acetate

CO_3^{2-} carbonate

CrO_4^{2-} chromate

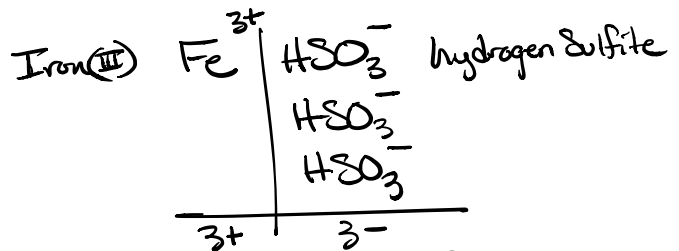
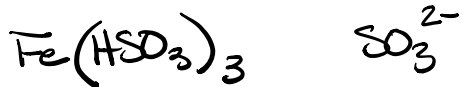
$\text{Cr}_2\text{O}_7^{2-}$ dichromate

(Main group metals)



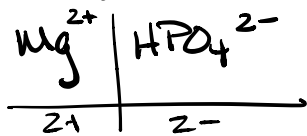
Sodium phosphate

(Transition Metals) S^{2-}

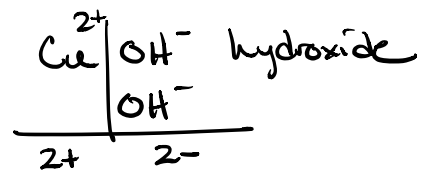


Iron(III) hydrogen sulfite
ferric hydrogen sulfite

Magnesium Mg^{2+} HPO_4^{2-} Hydrogen Phosphate



magnesium hydrogen phosphate



Copper(II) hydroxide
cupric hydroxide

Suffix

-ate "more oxygen" more than ite

-ite "less oxygen" less than ate

