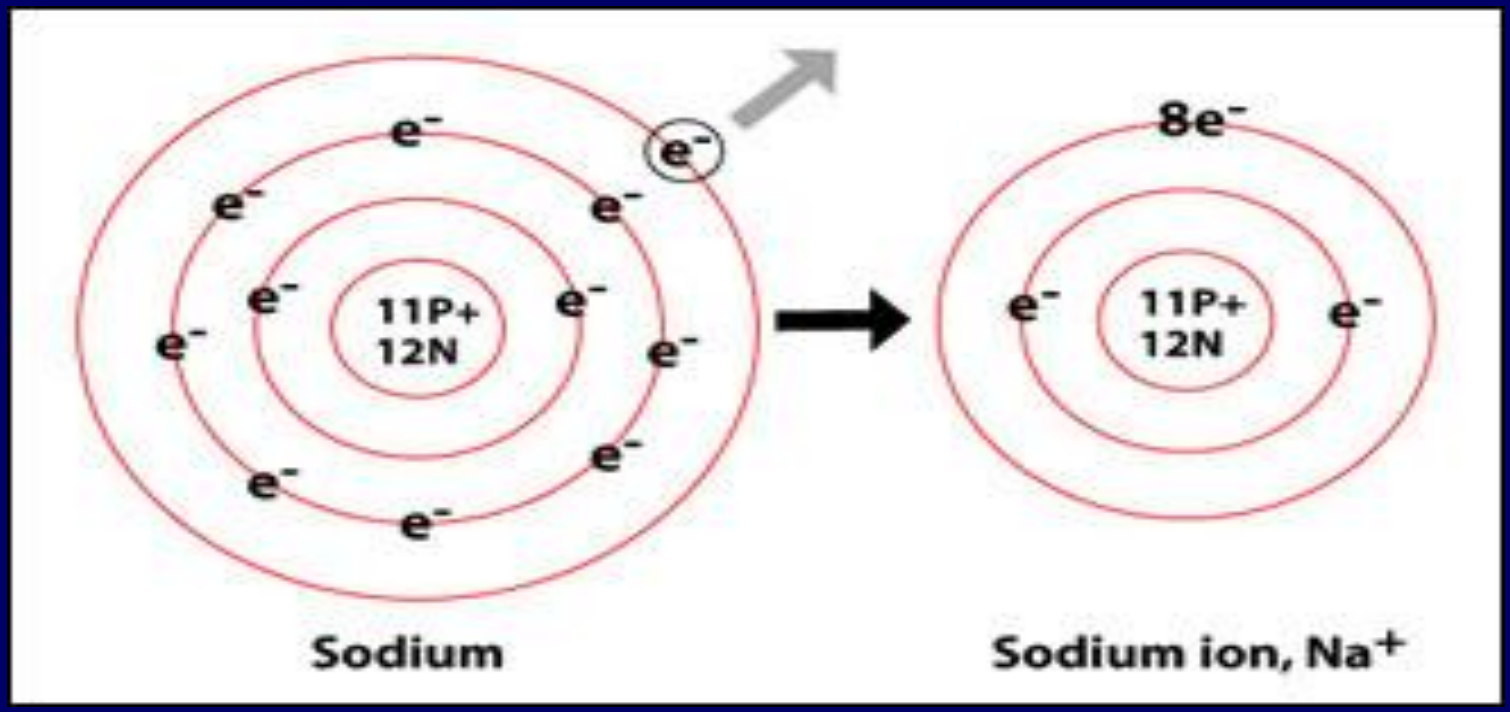
Review Notes Ch 8.1
Ionic Bonds

What is Chemical Bonding?

- **Chemical Bonding**-force that holds atoms together.
  - Atoms *share or lose/gain* **valence electrons**.
  - Atoms *share or lose/gain* electrons to be **stable**!
    - Full valence shells = **8 valence e^-** = stablity!
    - This is the "**octet rule**"-*rule of 8!*
  - **Sharing e^- = covalent compounds**
  - **Lose/gain e^- = Ionic Compounds**

Formation of Ions from Metals

- **Metals *lose* electrons to become stable**
- Metals form + ions = **cations**



Formation of Sodium Ion

Sodium atom **Sodium ion**

$Na^{\bullet}$ – e^- ⟶ Na^+

$1s^2\ 2s^2 2p^6\ \underline{3s^1}$ $1s^2\ \underline{2s^2 2p^6}$

2 + 8 + 1 2 + 8 (Ne e^- conf.)

11 p^+ **11 p^+**

11 e^- **10 e^-**

0 **1^+**

Formation of Magnesium Ion

Magnesium atom **Magnesium ion**

$\bullet Mg \bullet$ – $2e^-$ $\longrightarrow$ Mg^{2+}

$1s^2\ 2s^2 2p^6\ \underline{\mathbf{3s^2}}$ $1s^2\ \underline{2s^2 2p^6}$

2 + 8 + 2 2 + 8 (Ne e^- conf.)

12 p^+ **12 p^+**

12 e- **10 e^-**

0 **2^+**

Learning Check

Write the ion for each of the following:

A. 12 p^+ and 10 e^-

Mg^{2+}

B. 50p^+ and 46 e-

Sn^{4+}

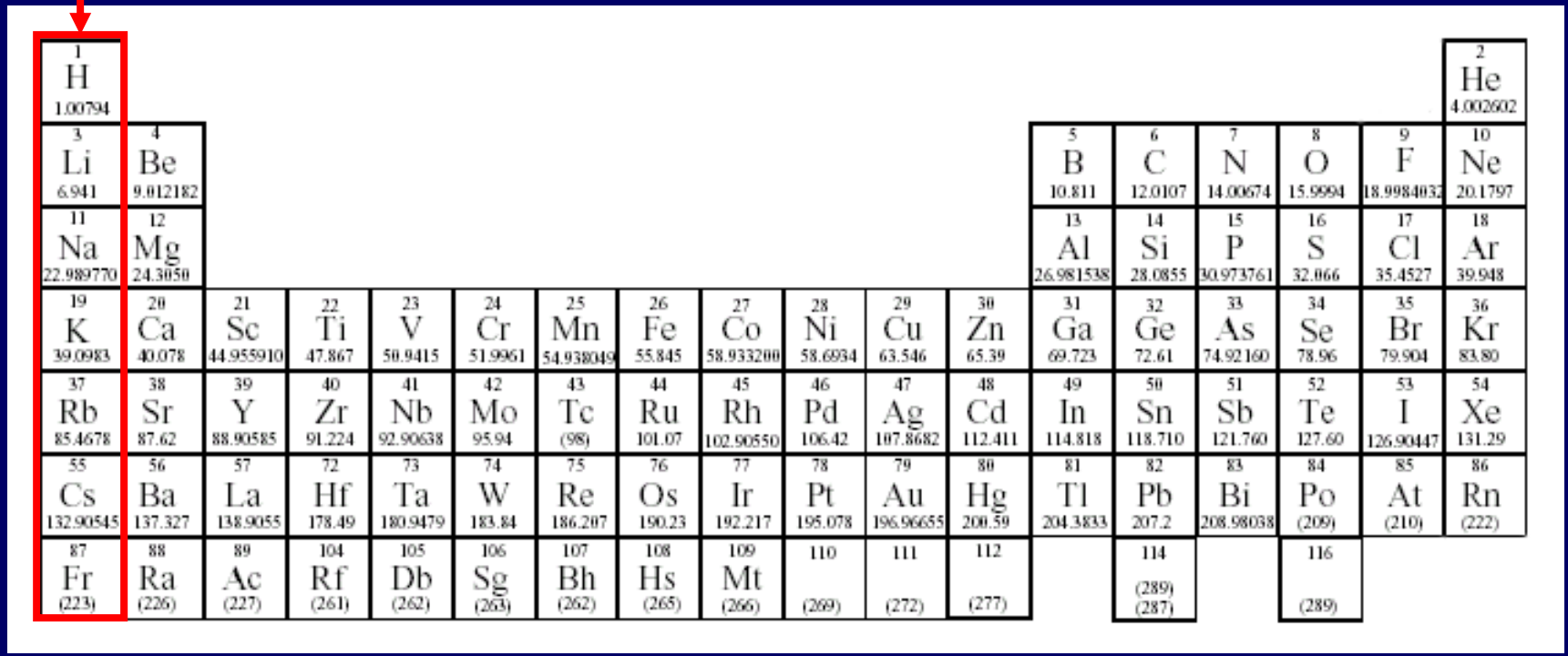
C. 15 p^+ and 18e-

P^{3-}

Predicting Cation Ionic Charges

Group 1: Lose 1 electron to form 1+ ions

H^+ Li^+ Na^+ K^+



1 H 1.00794																	2 He 4.002602
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11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)
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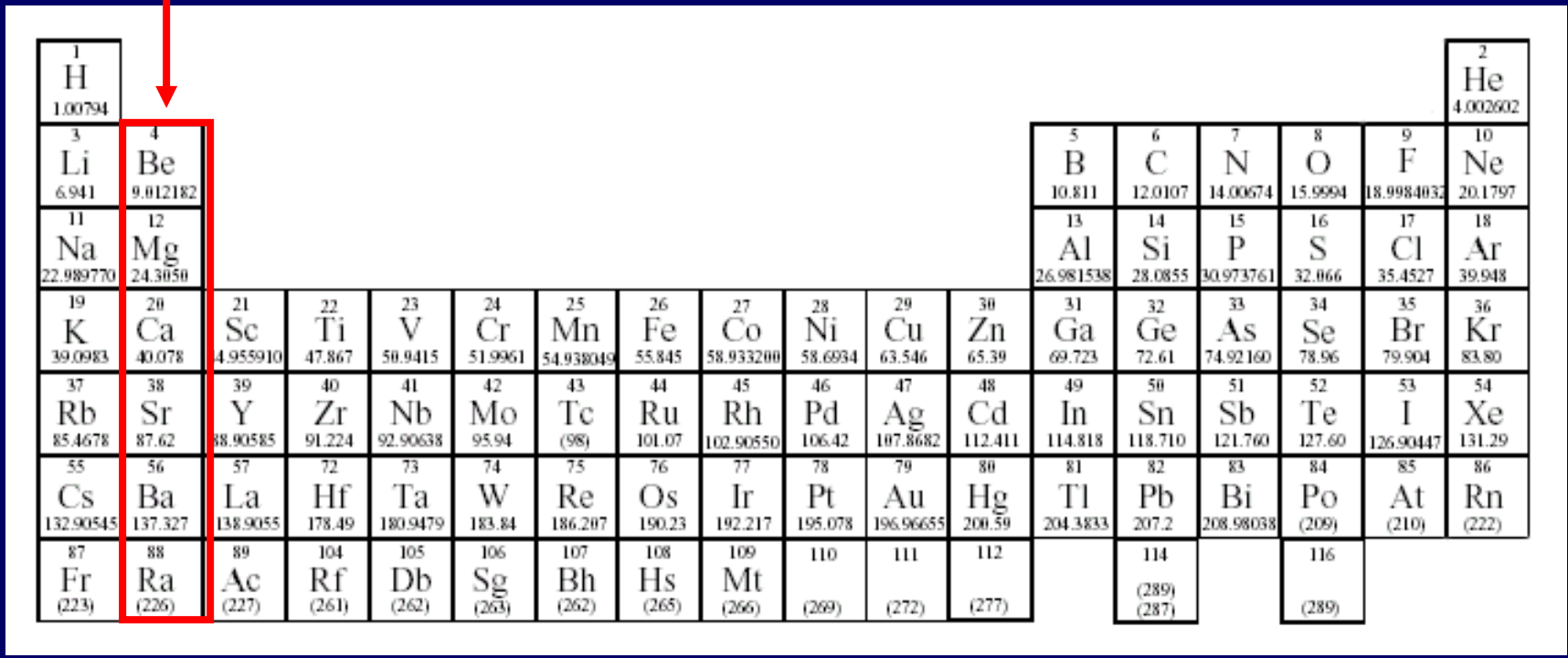
Predicting Cation Ionic Charges

Group 2: Loses 2 electrons to form 2+ ions

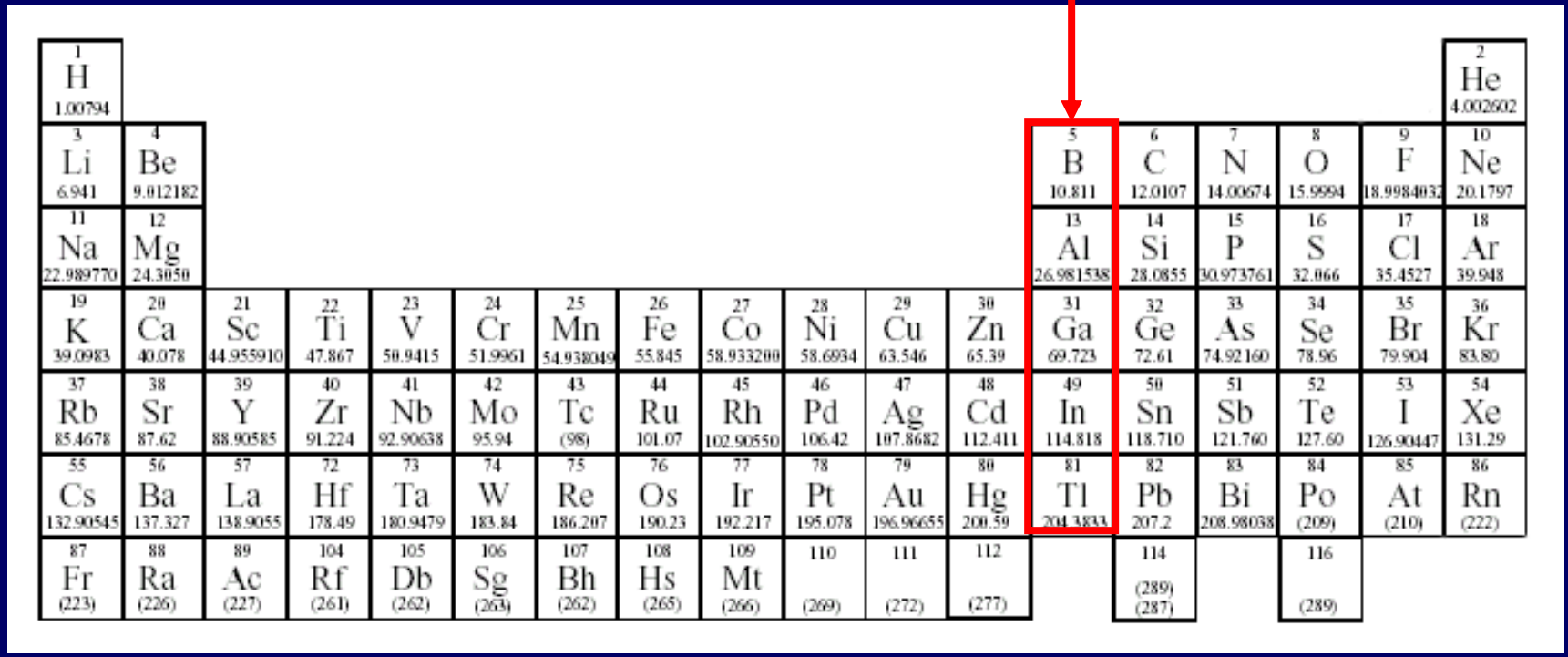
Be^{2+} Mg^{2+} Ca^{2+} Sr^{2+} Ba^{2+}



Predicting Cation Ionic Charges

B^{3+} Al^{3+} Ga^{3+}

Group 13: Loses 3 electrons to form 3+ ions



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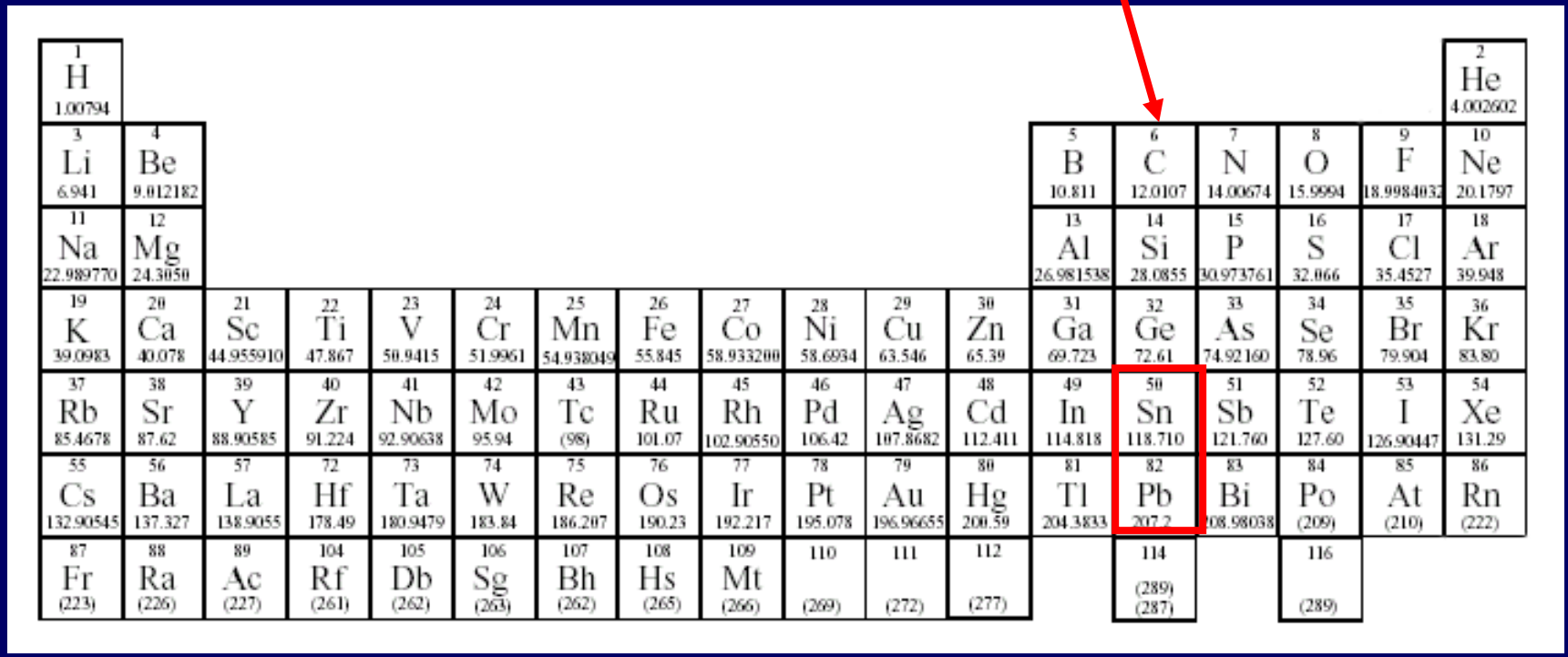
Predicting Ionic Charges

Sn^{4+} Pb^{4+}

Group 14: Loses 4 Electrons



Learning Check

A. Number of valence electrons in aluminum

1) 1 e^- 2) 2 e^- **3) 3 e^-**

B. Change in electrons for octet

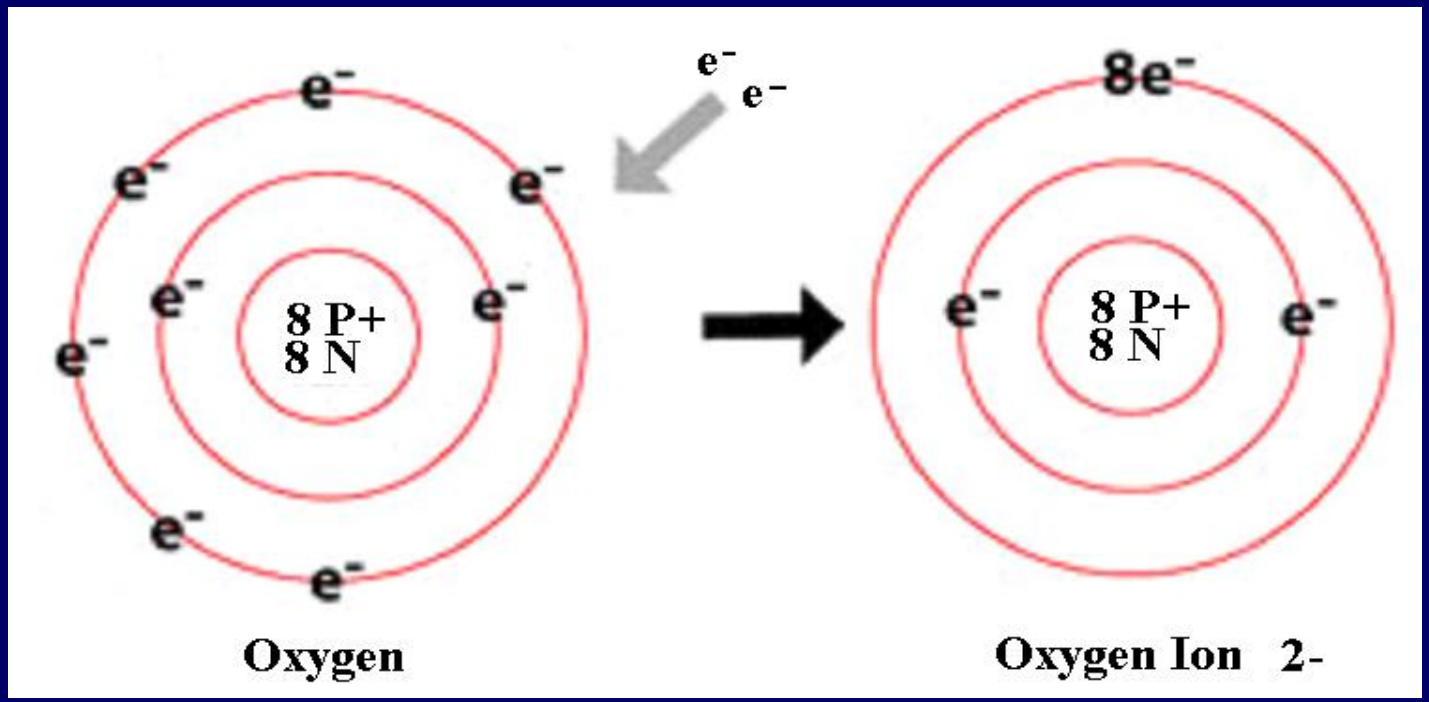
1) lose 3e^- 2) gain 3 e^- 3) gain 5 e^-

C. Ionic charge of aluminum

1) 3- 2) 5- **3) 3^+**

Formation of Ions from Nonmetals

- **Nonmetals *gain* electrons to become stable**
- Nonmetals form **-** ions = **anions**



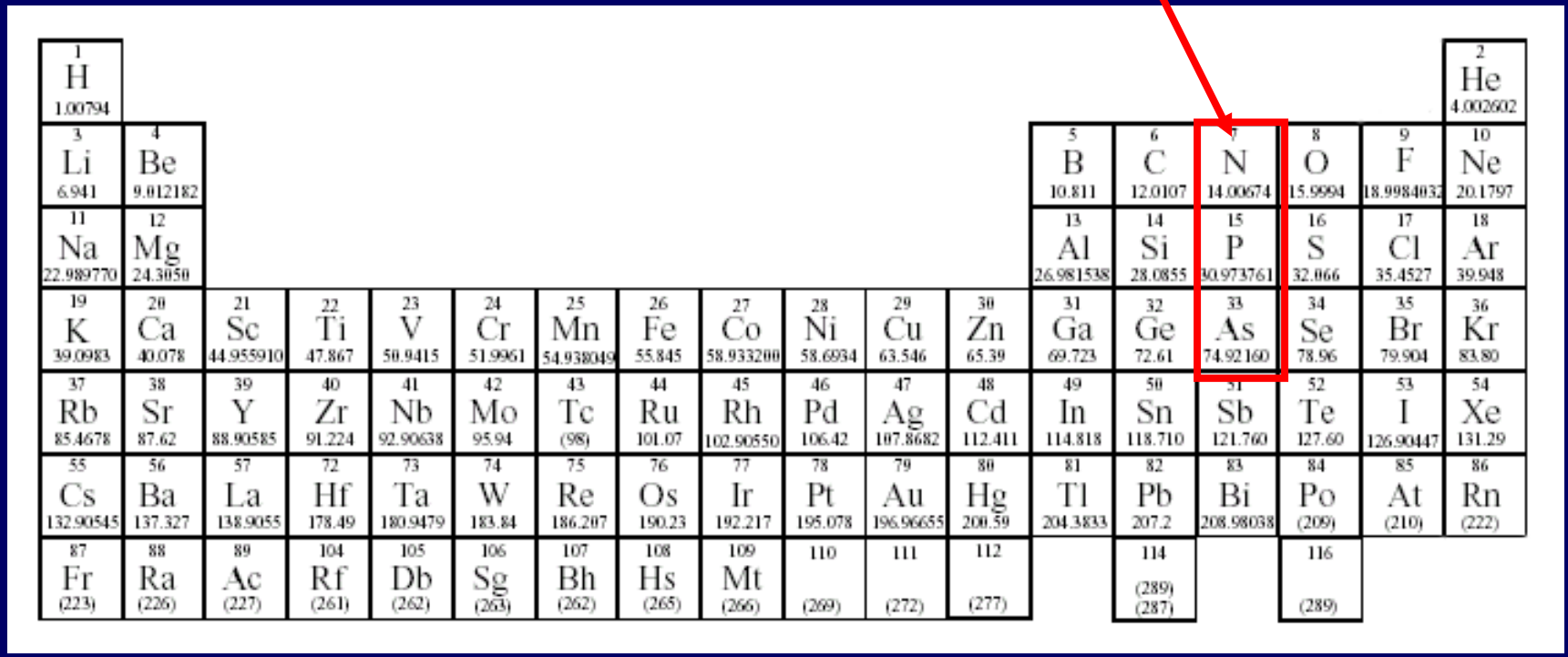
Predicting Ionic Charges

N^{3-} Nitride

P^{3-} Phosphide

As^{3-} Arsenide

Group 15: Gains 3 electrons to form 3- ions



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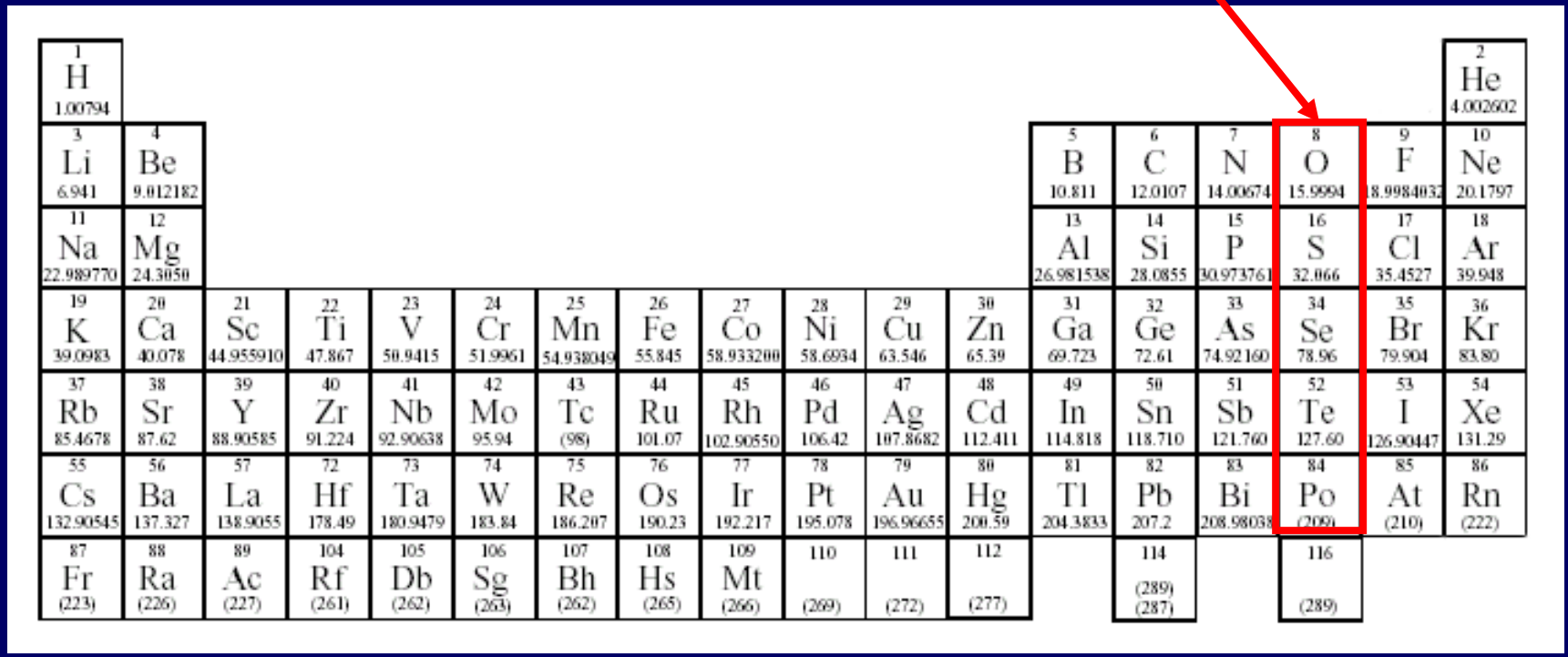
Predicting Ionic Charges

O^{2-} Oxide

S^{2-} Sulfide

Se^{2-} Selenide

Group 16: Gains 2 electrons to form 2- ions



Predicting Ionic Charges

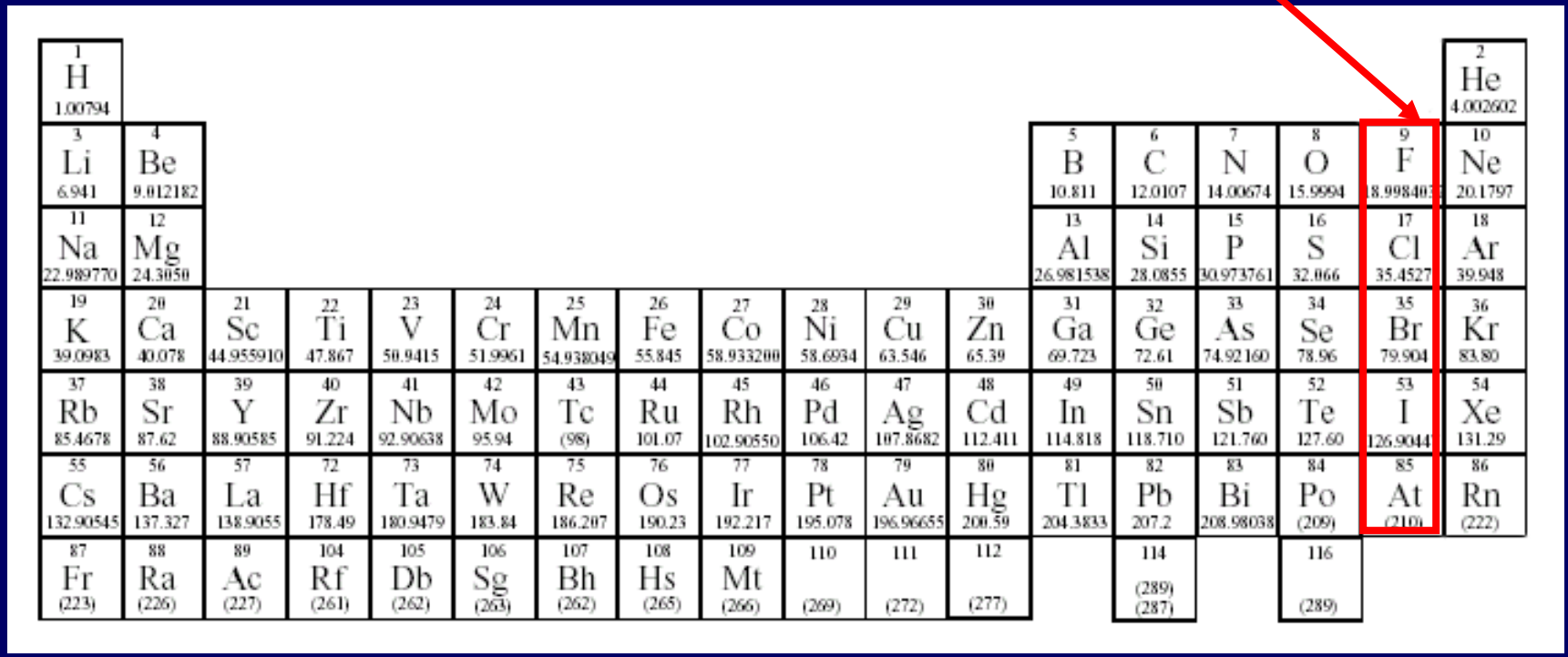
F^{1-} Fluoride

Br^{1-} Bromide

Cl^{1-} Chloride

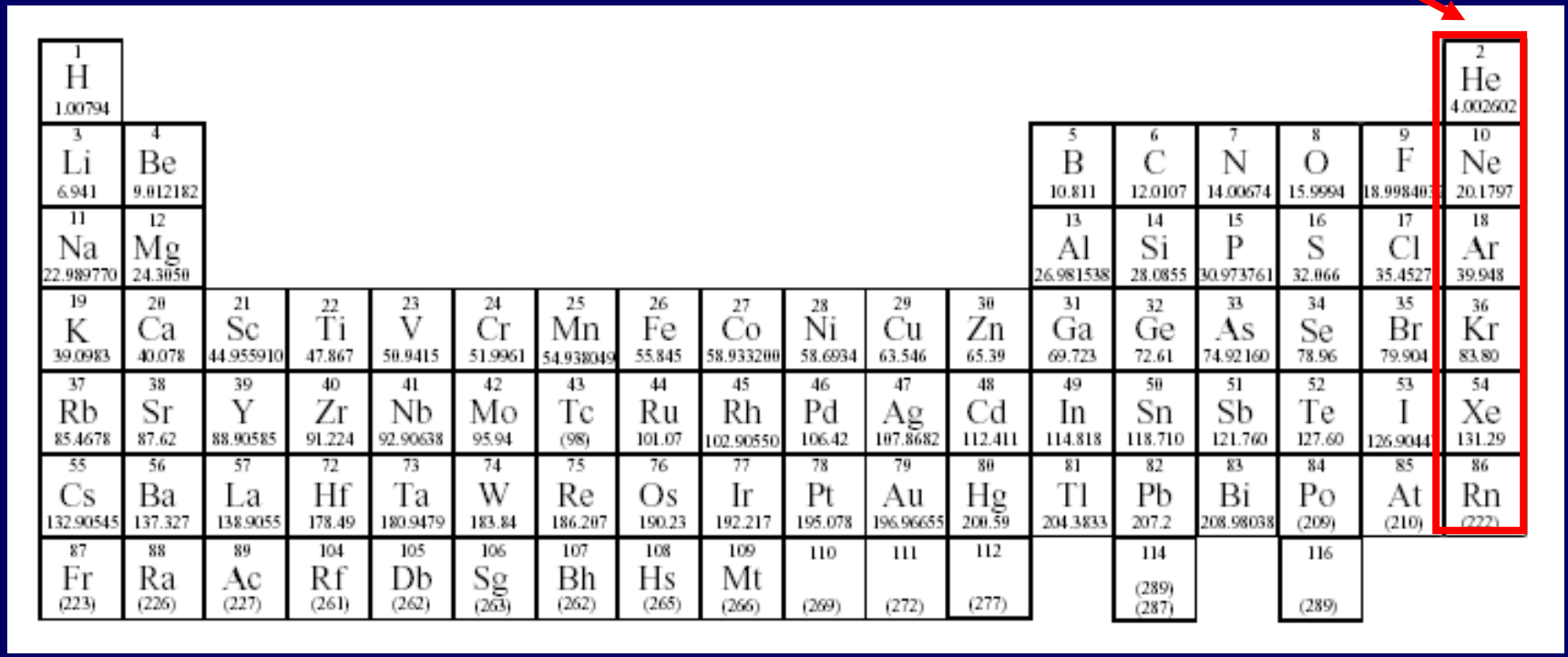
I^{1-} Iodide

Group 17: Gains 1 electron to form 1- ions



Predicting Ionic Charges

Group 18: Stable Noble gases do not form ions!



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Ionic Bonding – occurs when ions form an electrically-**NEUTRAL** compound by **transferring** electrons

Sodium and chlorine → Na^{+} Cl^{-} → NaCl

but

Calcium and nitrogen → Ca^{2+} N^{3-} → Ca_3N_2

Why??

Write the formula unit for the ionic compound is formed between these atoms:

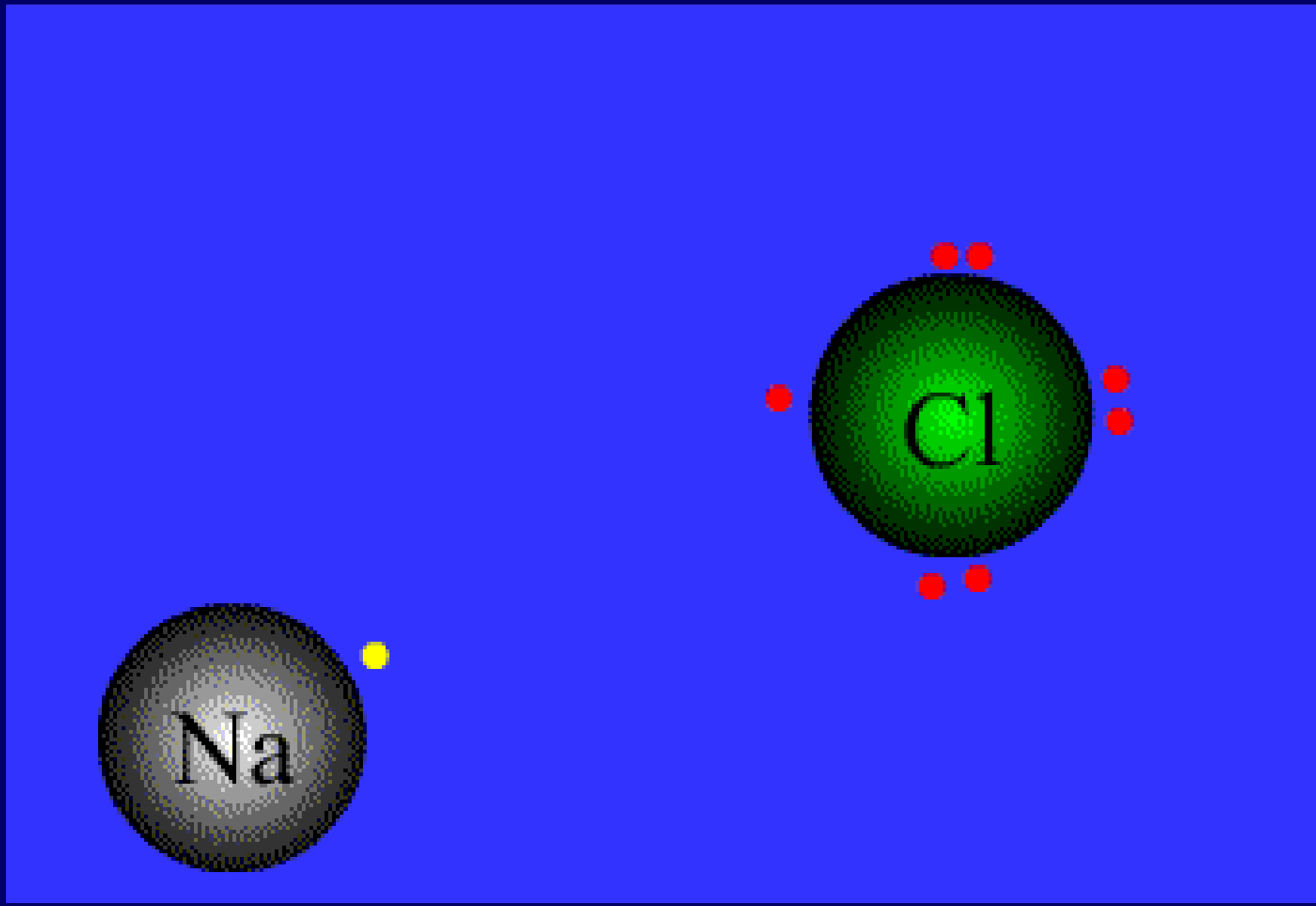
Example: Calcium and nitrogen

A. Aluminum and bromine

B. Potassium and oxygen

C. Lead(IV) and sulfur

Review Notes Ch 8.2
Ionic Bonds


Cl
Na

How Ionic Bonding Works

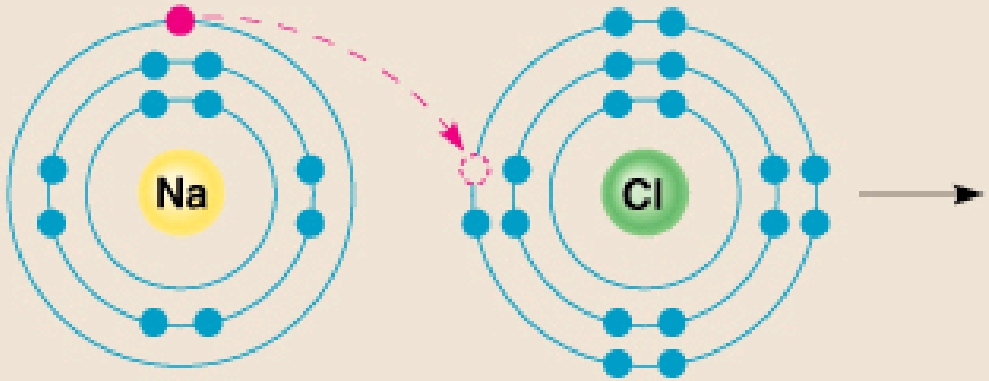
The negative and positively-charged ions are attracted to each other (like a magnet).

Ionic bonding –2 types

1 Metal ion + 1 Nonmetal ion

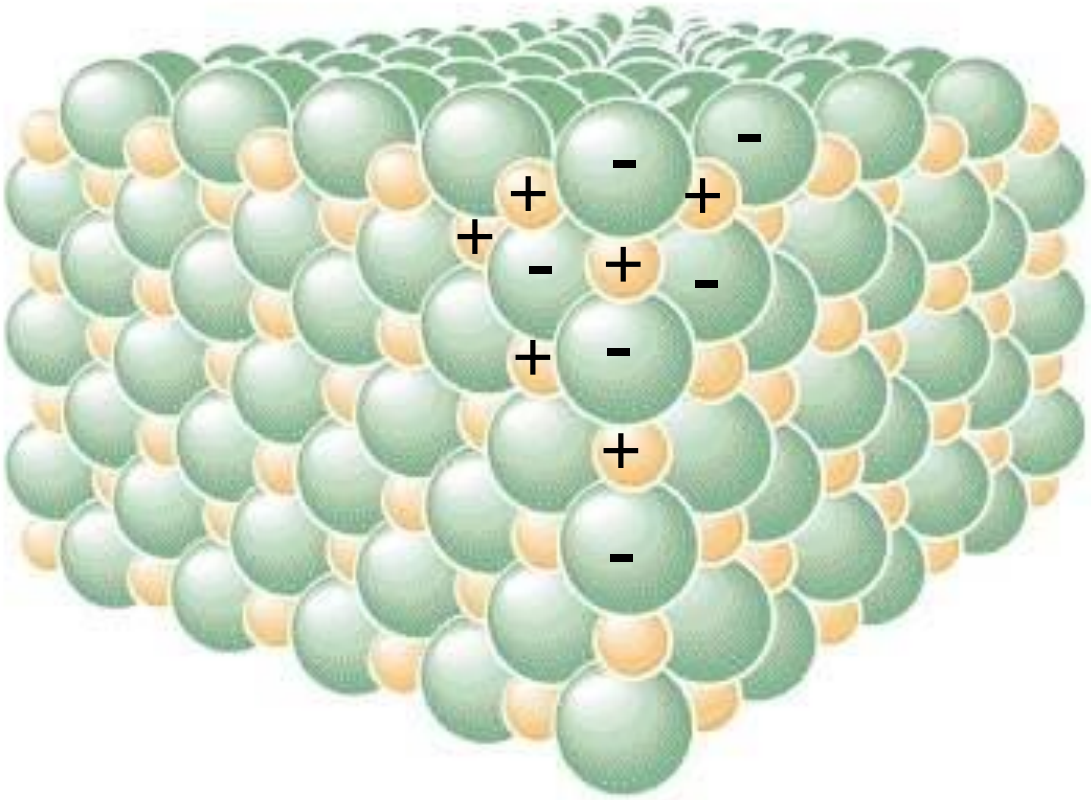
or

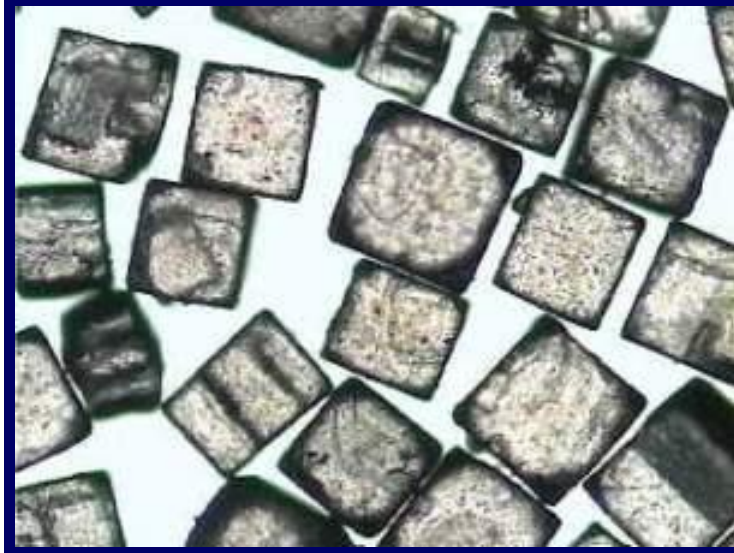
1 Metal ion + 1 Polyatomic ion



Sodium atom

Chlorine atom





Ionic cmpds form crystal lattices!

Repeating pattern of + & -

Ionic Bond

- Between atoms of metals and nonmetals with very different ***electronegativity***
- Very **STRONG attraction** to each other.
- Produce ***charged ions*** when separated.

  – $NaCl \xrightarrow{\text{Molten or dissolved}} Na^{+} + Cl^{-}$

  – $CaCl_2 \xrightarrow{\text{Molten or dissolved}} Ca^{2+} + 2\ Cl^{-}$

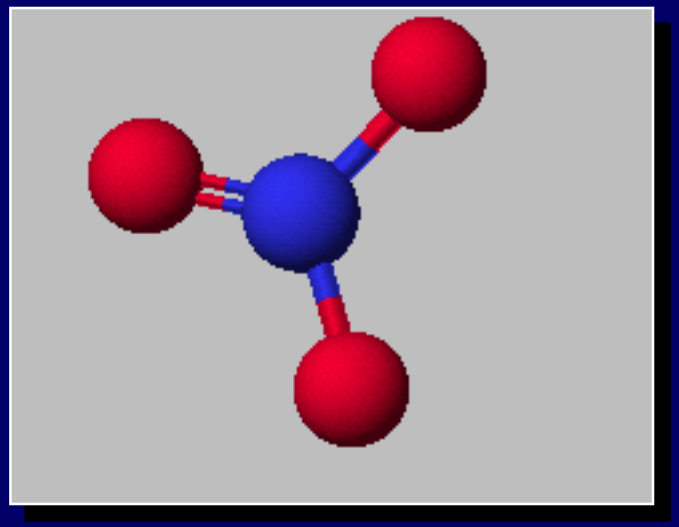
Ionic Properties

- **Conductors** of electricity if molten or dissolved.
  - Electrolytes!
- Have high melting point.
- High boiling points.
- **Solids**! Hard, rigid, brittle.

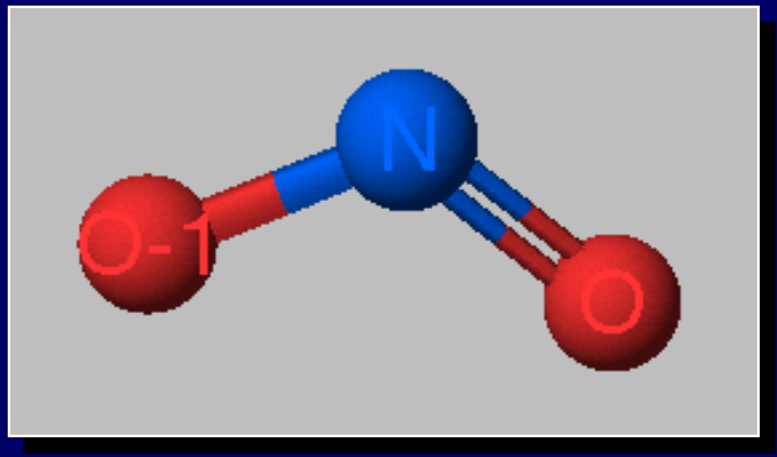
Formula	Cation	Compound Name
$FeCl_3$	(Fe^{3+})	iron (III) chloride
CuCl		
		tin (IV) fluoride
		lead (II) chloride
Fe_2S_3	(Fe^{3+})	
CuO		
		Lead(II)fluoride
CrO_3		
Cr_2O_3		

Polyatomic Ions - 8.3

NO_3^-
nitrate ion



NO_2^-
nitrite ion



Oxyion Nomenclature

Sodium Sulfate

Na^{+} and SO_4^{-2}

Na_2SO_4

Iron (III) hydroxide

Fe^{+3} and OH^{-}

$Fe(OH)_3$

Ammonium carbonate

NH_4^{+} and CO_3^{-2}

$(NH_4)_2CO_3$

Writing Formulas for Ternary Ionic Compounds

- Step 1– write cation then polyatomic
- Step 2 – Charges must equal zero!!!

  "Cross the charges" if they don't cancel out.
- Step 3-- Use **parentheses** for multiple polyatomic ions

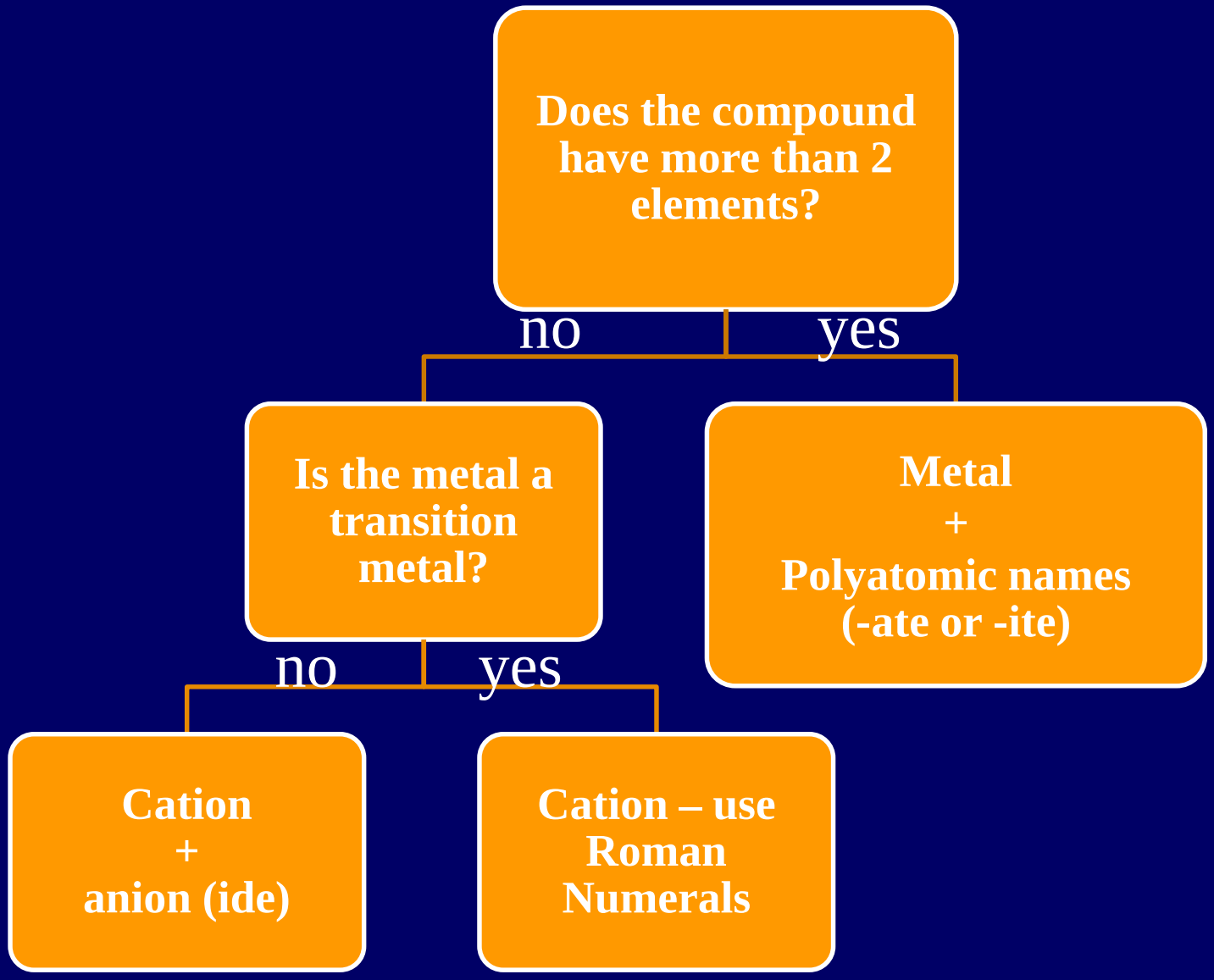
Practice Problems: Write the formula for each ionic compound.

copper(II) bromide $Cu^{+2}Br^{-1} = CuBr_2$ …(don't show 1's)

aluminum nitrite $Al^{+3}NO_2^{-1} = Al(NO_2)_3$

barium hydrogen carbonate $Ba^{+2}HCO_3^{-1} = Ba(HCO_3)_2$

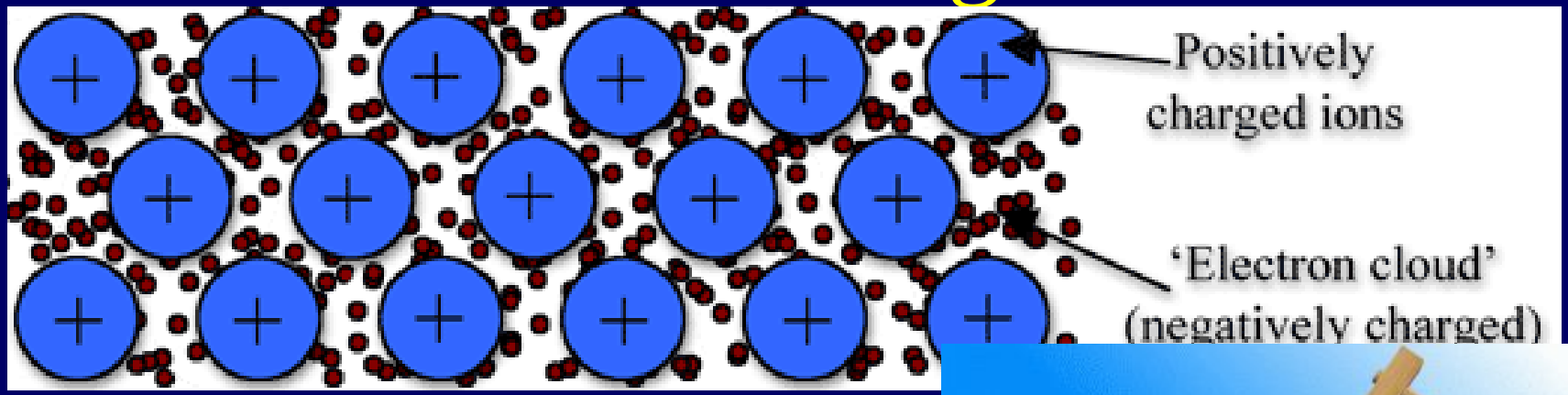
Naming Ionic Compounds



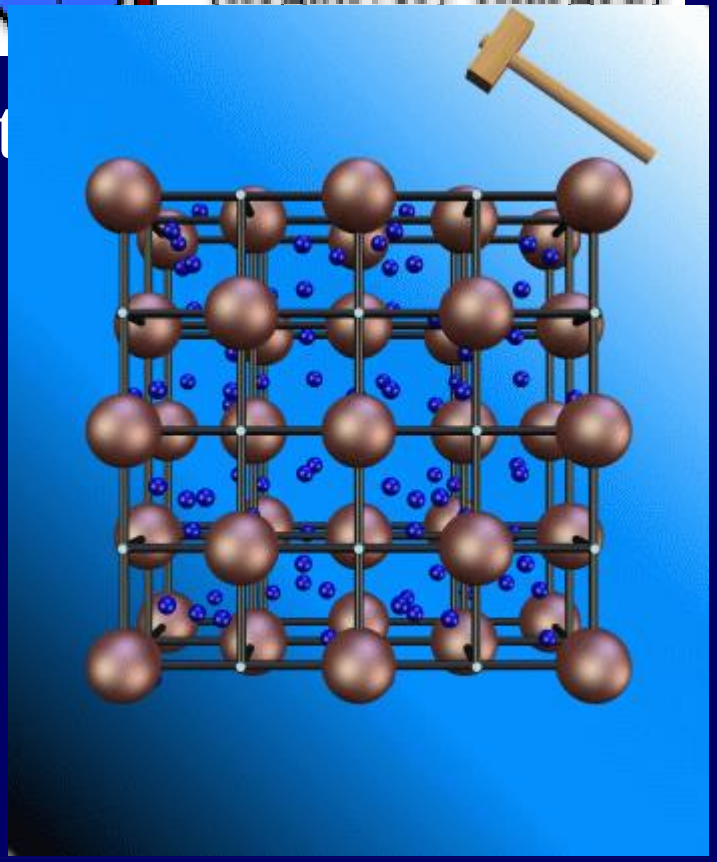
METALLIC BOND

bond found in metals; holds metal atoms together very strongly

Metallic Bonding - 8.4

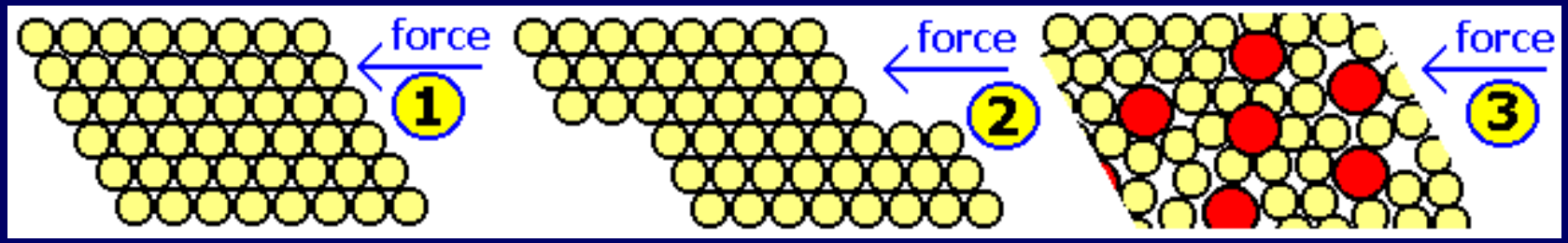


- Formed between atoms of met
- A very strong attraction
- Electron cloud around nuclei
- Good conductors at all states
- Lustrous, ductile, malleable
- Very high melting points



Metals Alloys

Metals do not combine with metals. They form **alloys** which is a solution of a metal in a metal.



Examples:

- Stainless steel - iron with chromium
- Brass - copper and zinc
- Bronze - copper with tin and …
- Pewter - tin with copper, antimony, tin, …

Formula Weights

- Formula weight is the sum of the atomic masses.
- Example- CO_2
- Mass, C + O + O

  12.011 + 15.994 + 15.994

  43.999

Practice

- Compute the mass of the following compounds round to nearest tenth & state type of bond:
- NaCl;
- 23 + 35 = 58; Ionic Bond
- C_2H_6;
- 24 + 6 = 30; Covalent Bond
- $Na(CO_3)_2$;
- 23 + 2(12 + 3x16) = 123; Ionic & Covalent