Binary Ionic Compounds

Review

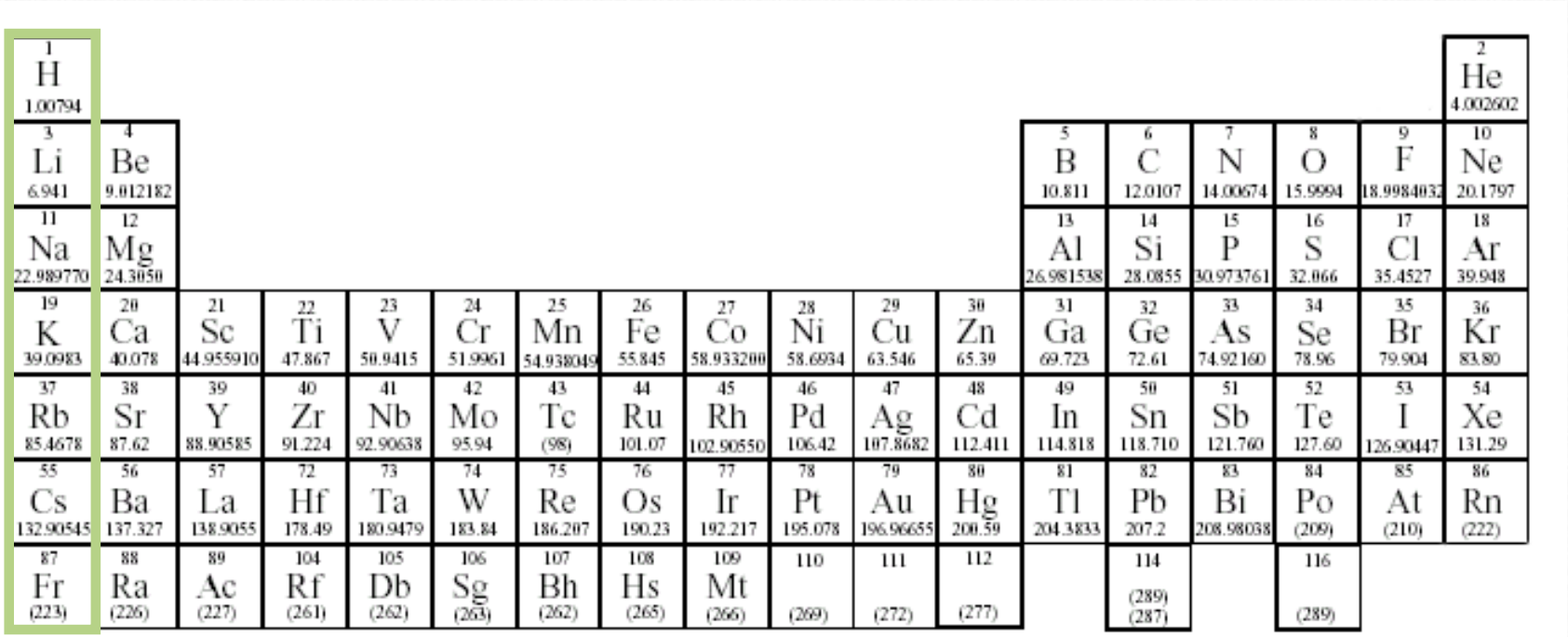
- At your table, discuss how you determine the charge of atoms based on the group it is in.

- Group 1A?
- Group 2A?
- Group 3A?
- Group B?
- Group 5A?
- Group 6A?
- Group 7A?

Review: Predicting Ionic Charges

Group 1A: Lose 1 electron to form 1+ ions

H^{1+} Li^{1+} Na^{1+} K^{1+} Rb^{1+}

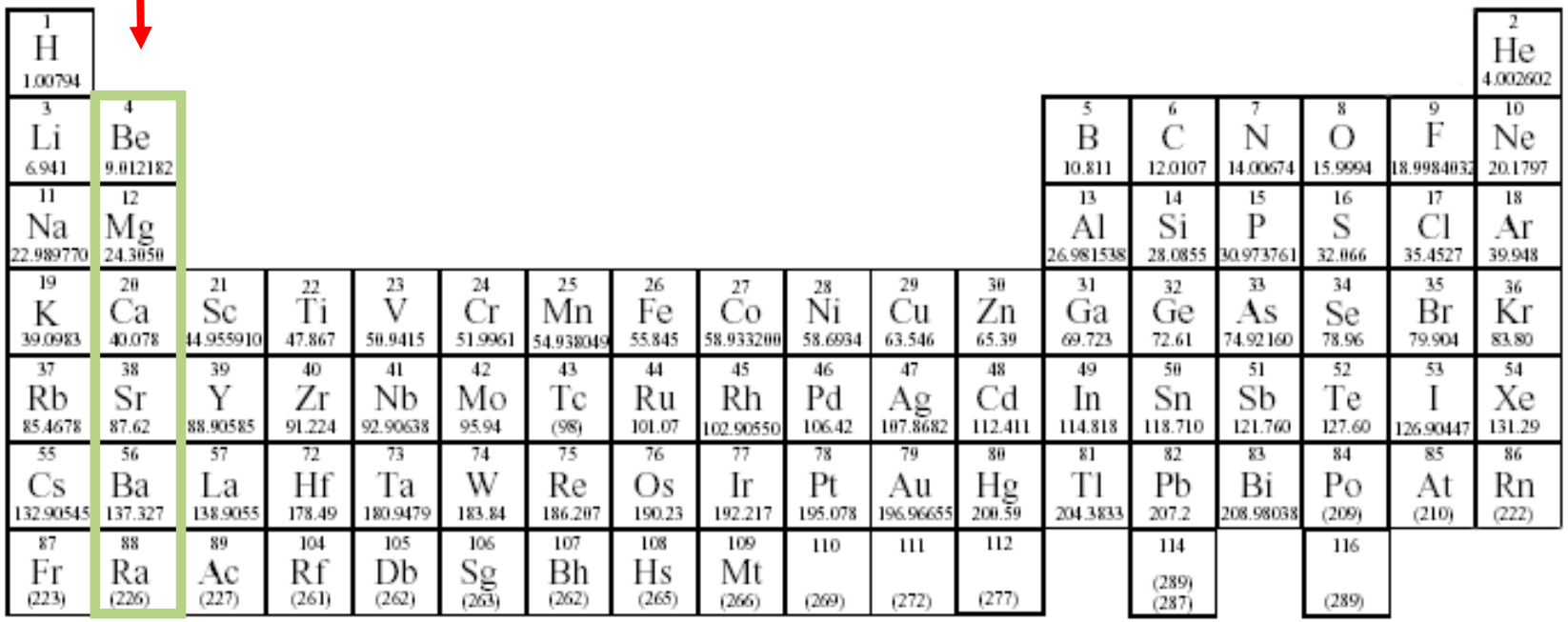


1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	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)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (289) (287)		116 (289)		

Predicting Ionic Charges

Group 2A: Loses 2 electrons to form 2+ ions

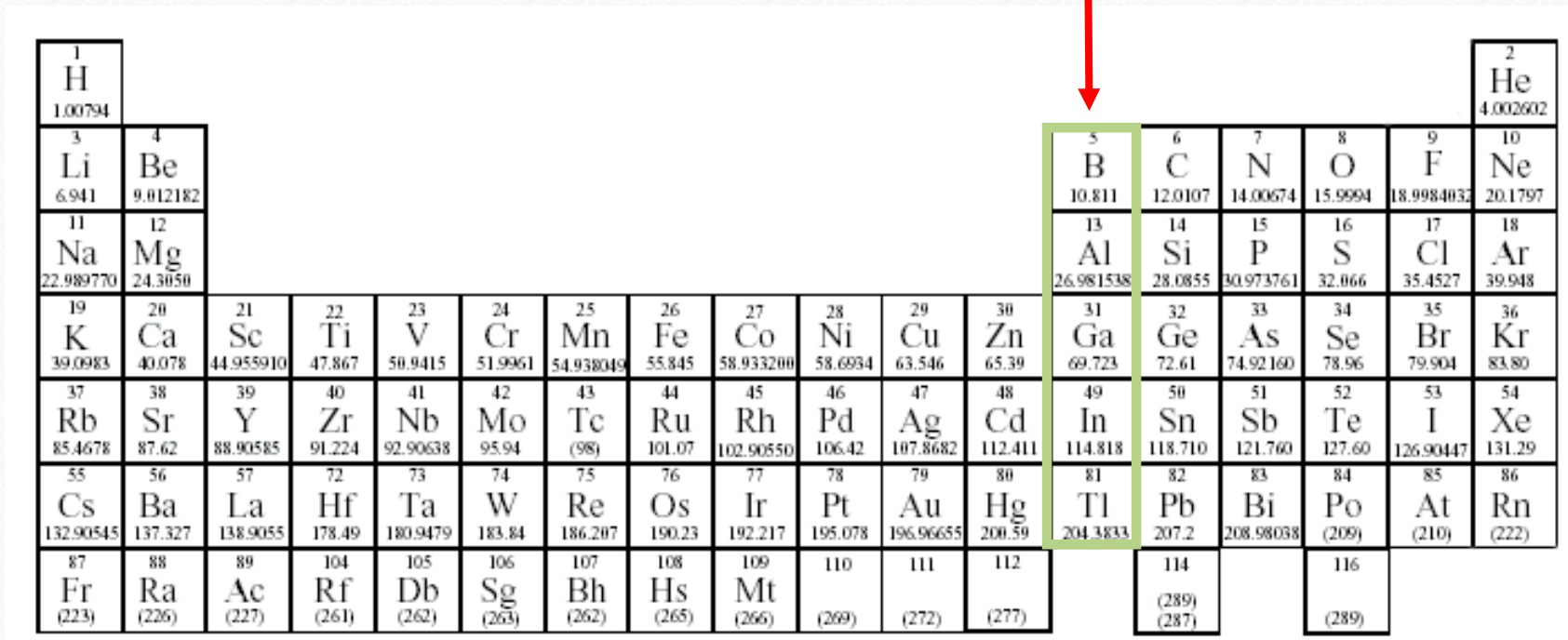
Be^{2+} Mg^{2+} Ca^{2+} Sr^{2+} Ba^{2+}



Predicting Ionic Charges

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

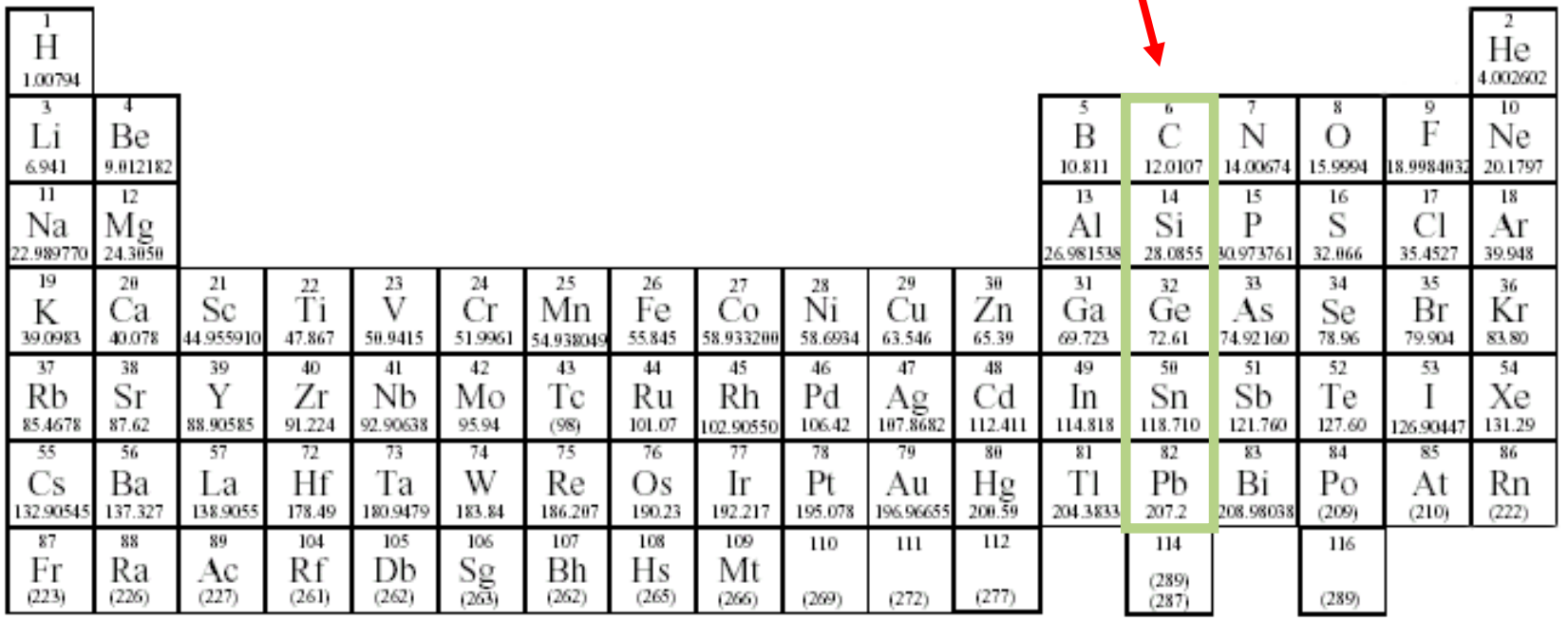
Group 3A: Loses 3 electrons to form 3+ ions



Predicting Ionic Charges

Neither! Group 4A elements rarely form ions (they tend to share)

Group 4A: Do they *lose* 4 electrons or *gain* 4 electrons?



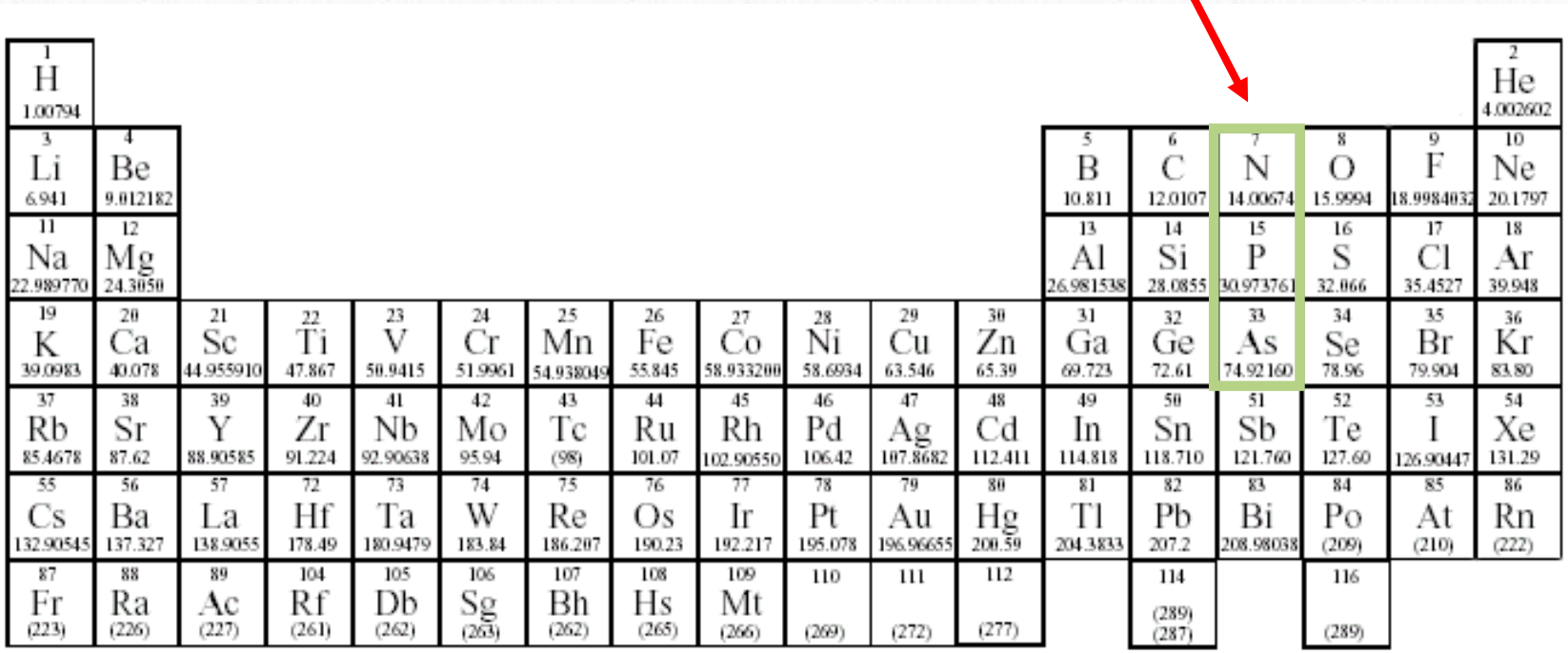
Predicting Ionic Charges

N^{3-} Nitride

P^{3-} Phosphide

As^{3-} Arsenide

Group 5A: Gains 3 electrons to form 3- ions



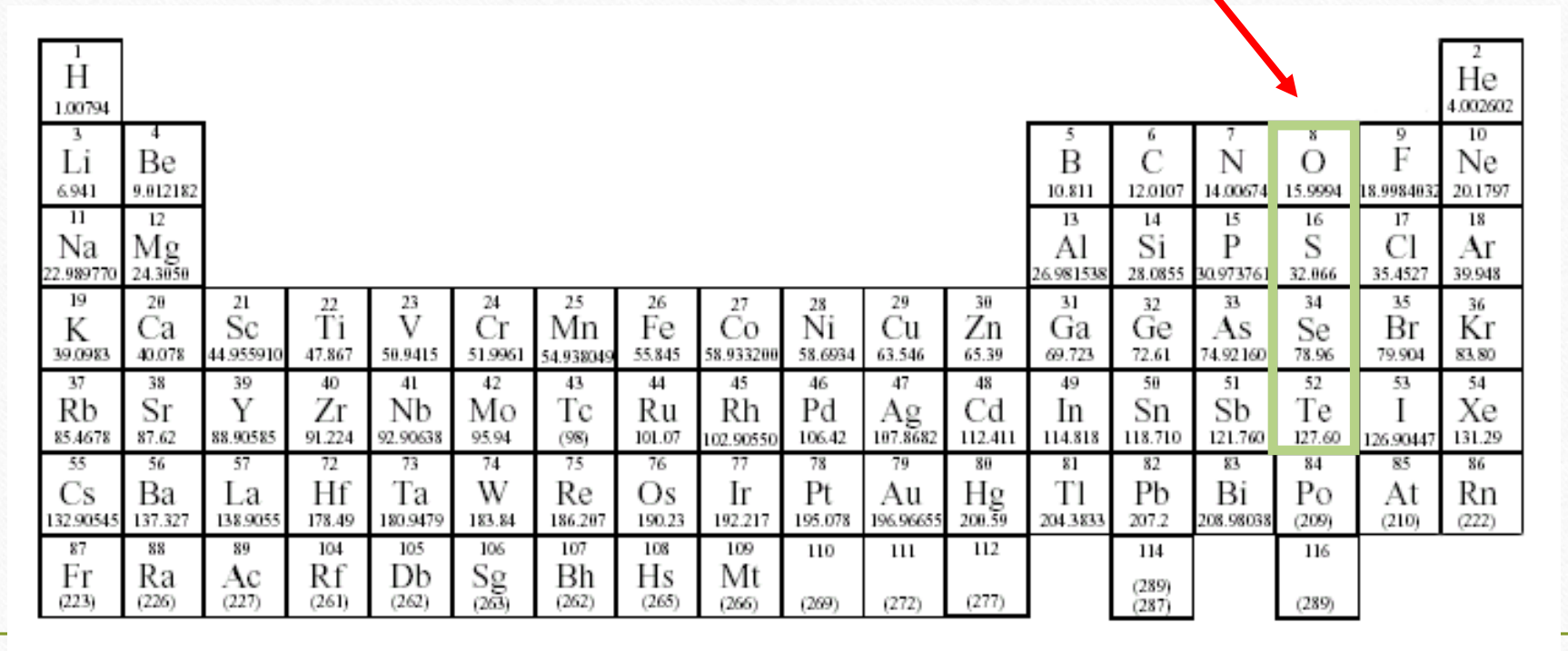
Predicting Ionic Charges

O^{2-} Oxide

S^{2-} Sulfide

Se^{2-} Selenide

Group 6A: Gains 2 electrons to form 2- ions

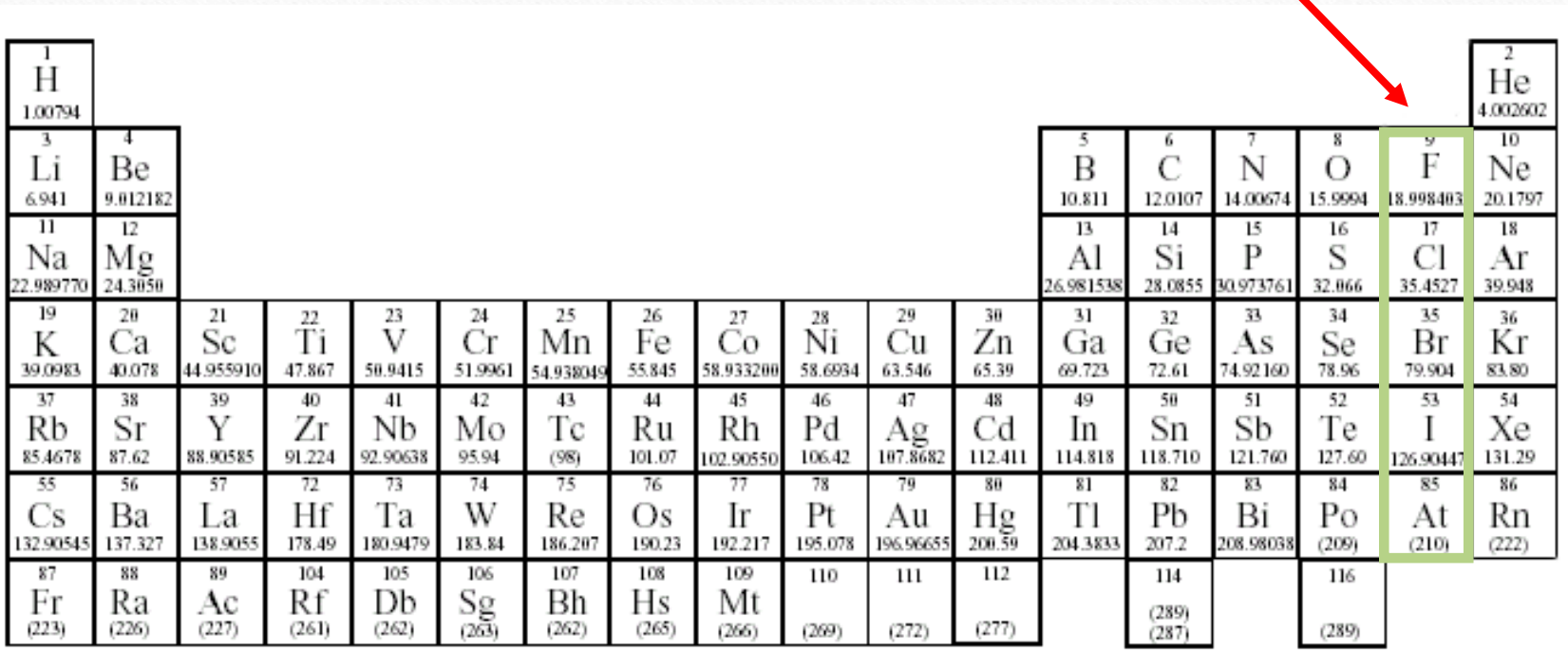


Predicting Ionic Charges

F^{1-} Fluoride **Br^{1-} Bromide**

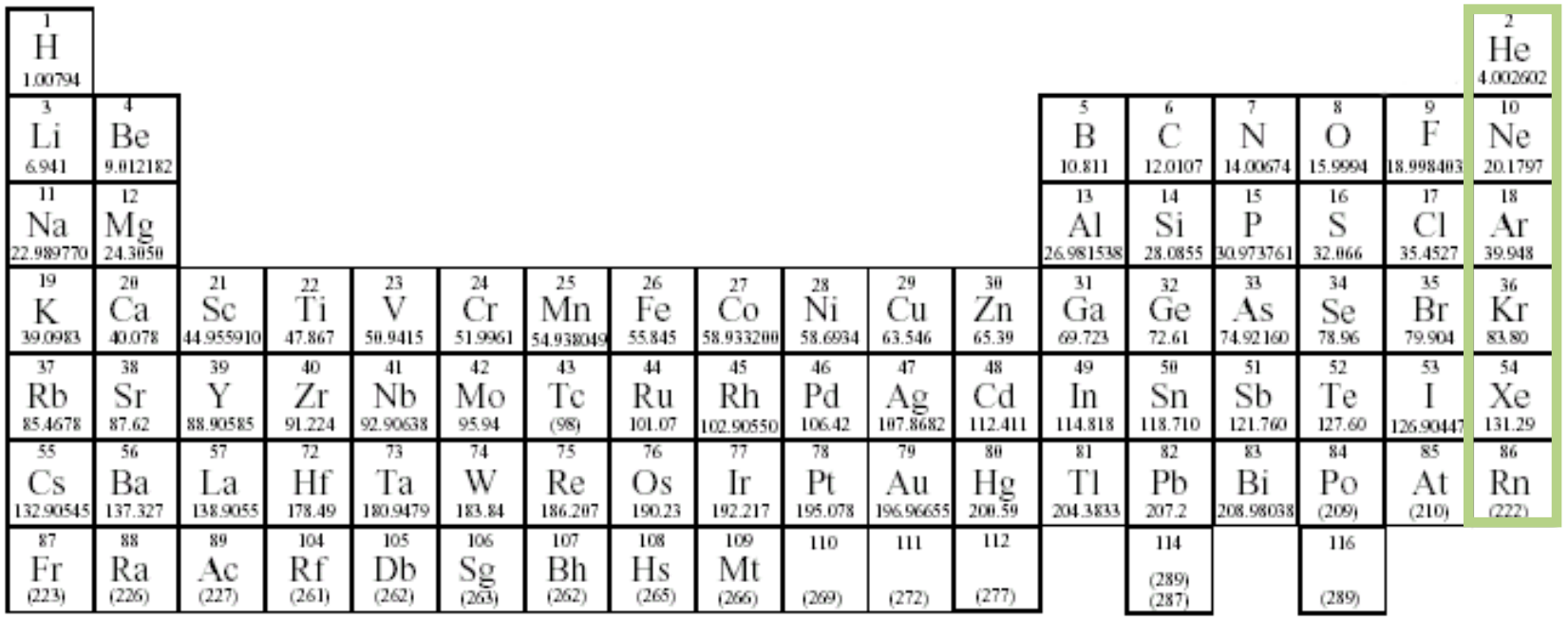
Cl^{1-} Chloride **I^{1-} Iodide**

Group 7A: Gains 1 electron to form 1- ions



Predicting Ionic Charges

Group 8A: Stable noble gases do not form ions!



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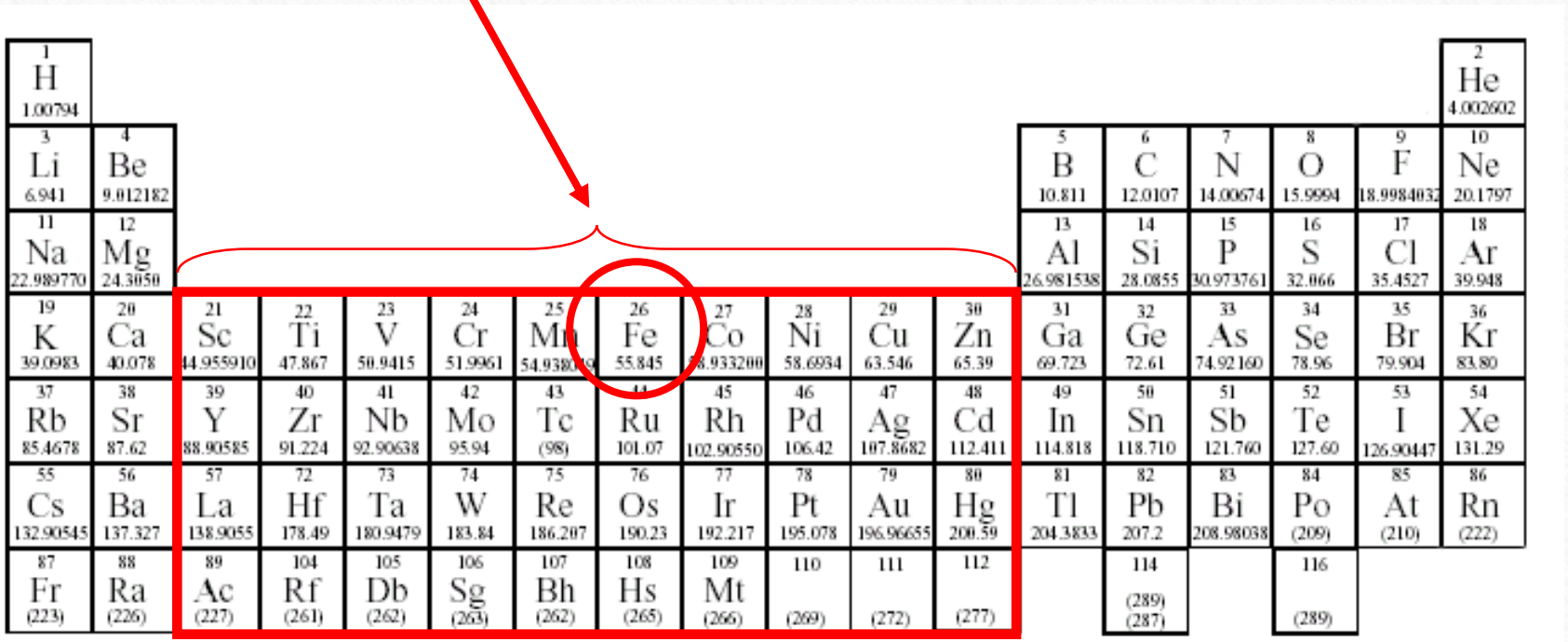
Predicting Ionic Charges

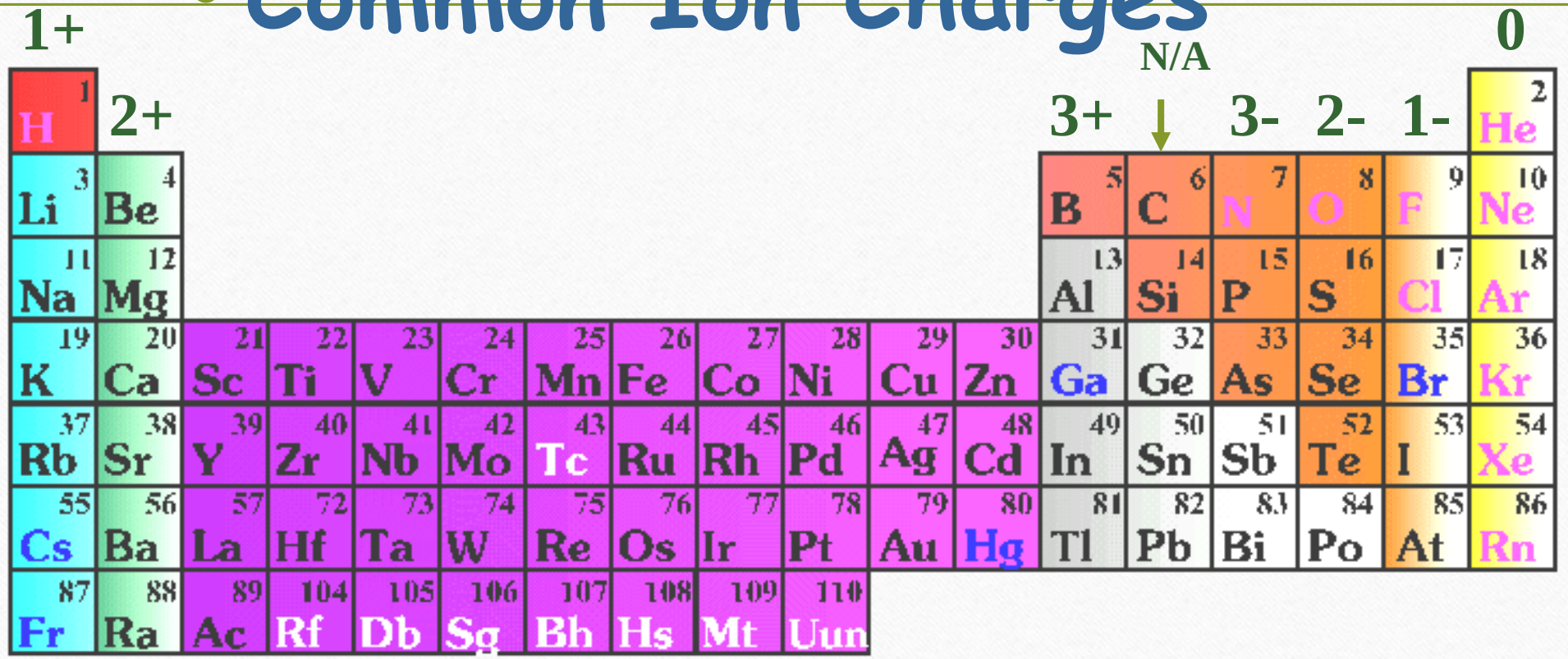
Group B elements: transition metals have *multiple charges and are harder to predict*

Iron (II) = Fe^{2+}

Iron (III) = Fe^{3+}

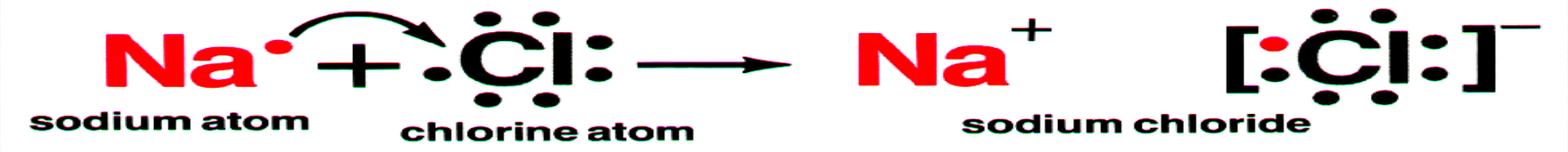


Common Ion Charges



A. Making compounds to balance charge

1. charges should always add up to zero
2. Add subscripts to show # of ions
3. Write cation first and anion second



A. Making compounds to balance charge

- 4. Ex: Strontium and Fluorine

Sr = 2+ (group 2A) F = 1- (group 7A)

Sr^{2+} F^{1-} = 1+

F^{1-}

SrF_2 = 0

subscripts show the # of ions

- Ex: Calcium and Phosphorous

Ca^{2+} P^{3-}

Ca^{2+} P^{3-}

Ca^{2+}

Ca_3P_2

White boards please

- Your Turn:
  - Lithium and Bromine
  - Calcium and Iodine
  - Oxygen and Barium

- LiBr
- CaI_2
- BaO

B. Naming ionic compounds

1. Name the cation first

   a. Metals with multiple charges use roman numerals to show the charge on the metal (mostly transition metals)

      - Ex: Iron (II) is Fe^{2+}

B. Naming ionic compounds

2. Name the anion second

a) Monatomic - change ending to -ide

b) Polyatomic- name stays the same

B. Naming ionic compounds

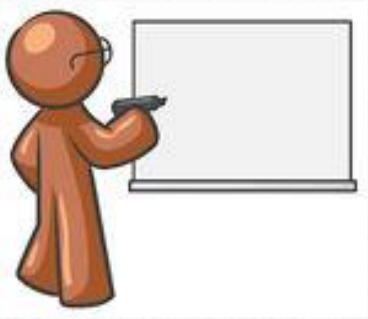
- 3. To determine which is the cation and which is the anion, draw a line after the metal or ammonium (NH_4)

B. Naming ionic compounds

3. Examples

- $CaCl_2$ = **Calcium chloride**
- $NaBr$ = **Sodium bromide**
- K_3N = **potassium nitride**

Your Turn



Na_2O	**sodium oxide**
Ca_3N_2	**Calcium Nitride**
$AlCl_3$	**Aluminum chloride**

C. Name to Formula

potassium chloride $K^+ \ Cl^- \Rightarrow KCl$

magnesium Sulfide $Mg^{2+} \ S^{2-} \Rightarrow MgS$

C. Name to Formula

Aluminum oxide Al^{3+} O^{2-} $\Rightarrow Al_2O_3$

Al^{3+} O^{2-}

O^{2-}

D. Multi-Charge (Transition) Metals

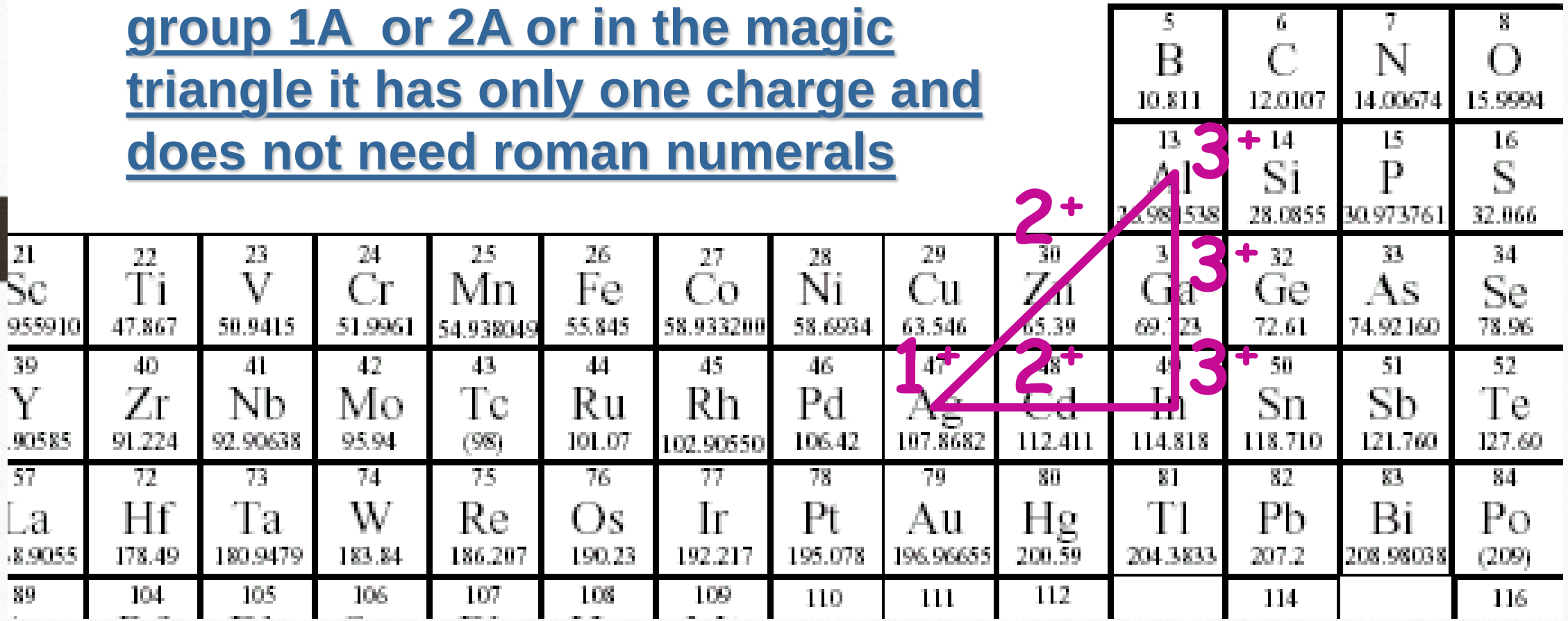
- Roman numerals are only used if the metal has more than one possible charge. Use the periodic chart of charges.
- Do not use roman numerals for single charge transition metals (ex: AgCl = silver chloride)

NUMERALS 1-10

1	=	I	6	=	VI
2	=	II	7	=	VII
3	=	III	8	=	VIII
4	=	IV	9	=	IX
5	=	V	10	=	X

Remember the Magic Triangle

If it is a metal (left of the stair case) in group 1A or 2A or in the magic triangle it has only one charge and does not need roman numerals



Examples: Write formula or Name

1. Iron (II) Sulfide

2+

Fe^{2+} S^{2-}

FeS

2. Gold (III) oxide

3+

Au^{3+} O^{2-}

Au^{3+} O^{2-}

O^{2-}

Au_2O_3

$CuBr_2$ = Copper (II) Bromide

When naming compounds with multi-charge metals, you must work backwards to determine the charge

$Cu^{?}$ Br^{-}
Br^{-}

2^{+} 2^{-}

Copper (I) = Cu^{+}
Copper (II) = Cu^{2+}

FeO = Iron (II) Oxide

When naming compounds with multi-charge metals, you must work backwards to determine the charge

$Fe^{?}$ O^{2-}

2^{+} 2^{-}

Fe_2S_3 = Iron (III) Sulfide

$Fe^{?}$ S^{2-}

$Fe^{?}$ S^{2-}

S^{2-}

6^{+} 6^{-}

When naming compounds with multi-charge metals, you must work backwards to determine the charge