NAMING COMPOUNDS

Nomenclature: Naming Compounds

- There are 2 main types of *bi*nary compound: *compounds composed of 2 or more elements.*

  1. **Ionic compound**: compounds that contain a metal and a non-metal.

  2. **Covalent molecule**: compounds that contain two non-metals.

TYPE I
BINARY IONIC COMPOUNDS

(Not transitional metals)

Type 1 is what we did in Unit 1!!!

- Forms between 2 ions
- Cation (+) is always named first and the anion (-) second
- Cation takes its name from the name of the element
- End of name is “ide”
- The net charge on an ionic compounds is always zero.

- sodium chloride

$Na^+ + Cl^- \longrightarrow NaCl$ (does the charge add to 0?)

(+1) + (-1) = 0

Use crisscross method to determine # of atoms

calcium chloride

$Ca^{2+} + Cl^- \longrightarrow CaCl_2$ (does the charge add to 0?)

(+2) + 2(-1) = 0

strontium nitride

$Sr^{2+} + N^{3-} \longrightarrow Sr_3N_2$

3(+2) + 2(-3) = 0

Practice

- Name the following Type I binary compounds:

  CsF

  $AlCl_3$

  MgI_2

  Rb_2O

  SrI_2

  K_2S

POLYATOMIC (IONIC)

Common Polyatomic Ions

TABLE 4.4

Names of Common Polyatomic Ions

Ion	Name	Ion	Name
NH_4^+	ammonium	CO_3^{2-}	carbonate
NO_2^-	nitrite	HCO_3^-	hydrogen carbonate (bicarbonate is a widely used common name)
NO_3^-	nitrate		
SO_3^{2-}	sulfite		
SO_4^{2-}	sulfate	ClO^-	hypochlorite
HSO_4^-	hydrogen sulfate (bisulfate is a widely used common name)	ClO_2^-	chlorite
		ClO_3^-	chlorate
		ClO_4^-	perchlorate
OH^-	hydroxide	$C_2H_3O_2^-$	acetate
CN^-	cyanide	MnO_4^-	permanganate
PO_4^{3-}	phosphate	$Cr_2O_7^{2-}$	dichromate
HPO_4^{2-}	hydrogen phosphate	CrO_4^{2-}	chromate
$H_2PO_4^-$	dihydrogen phosphate	O_2^{2-}	peroxide

- Forms with an ion made of many atoms: Act as a single ion; Mostly anions (exception NH_4^+)
- Need to use ( ) when there are multiples of a polyatomic ion
- Example: $Ca(OH)_2$ NOT $CaOH_2$

($1\ Ca^{2+}$ and $2\ OH^-$)

calcium hydroxide

- aluminum hydroxide

$Al^{3+} + (OH)^{-} \longrightarrow Al(OH)$ (check the charge)

+3 + -1 = +2 (what should we do)

CRISSCROSS!!!!! REMEMBER TO PUT ( ) AROUND THE POLYATOMIC

$Al^{3+} + OH^{-} \longrightarrow Al(OH)_3$

- ammonium sulfate

$(NH_4)^{+} + (SO_4)^{2-} \longrightarrow$ (check the charge)

+1 + -2 = -1 (what should we do)

$(NH_4)^{+} + (SO_4)^{2-} \longrightarrow (NH_4)_2SO_4$

Practice

- Name the following compounds:

  Na_2CO_3

  Na_3PO_4

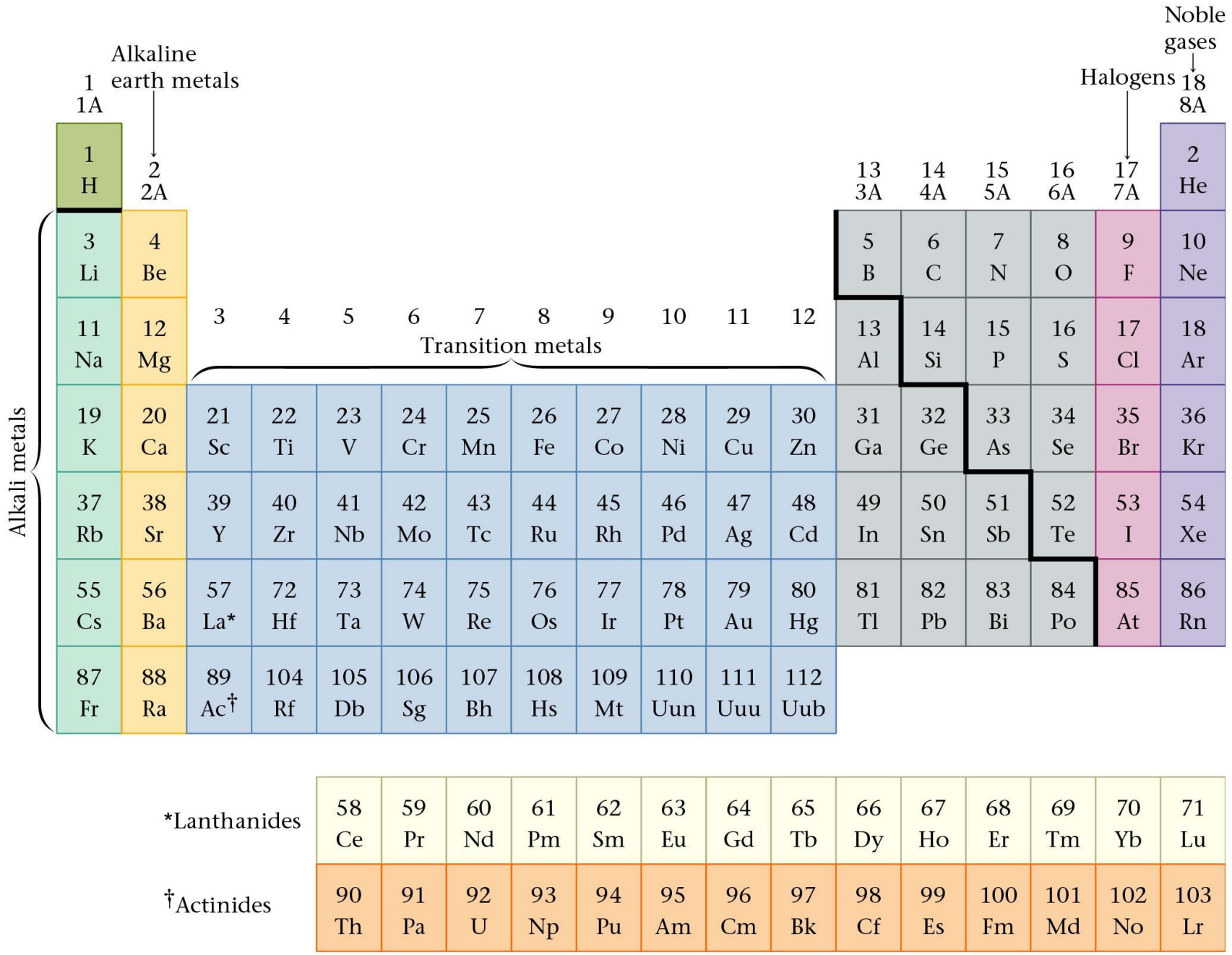
  $(NH_4)_2Cr_2O_7$

TYPE II

BINARY IONIC COMPOUNDS

(TRANSITION METALS)

(Know where the transitional metals are located on your periodic table)


Noble gases
Alkaline earth metals
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1 1A
2 2A
13 3A
14 4A
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Alkali metals
3 4 5 6 7 8 9 10 11 12
Transition metals
1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
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
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
55 Cs
56 Ba
57 La*
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
87 Fr
88 Ra
89 Ac†
104 Rf
105 Db
106 Sg
107 Bh
108 Hs
109 Mt
110 Uun
111 Uuu
112 Uub
*Lanthanides
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
71 Lu
†Actinides
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
103 Lr

- Many metals can form more than one type of cations, such as most of the transitions metals.
- The cation name still goes first, and the anion second. Ending is still “ide”
- Identify the charge of the anion to help determine the cation charge.
- Use roman numerals to indicate charge
  - If the roman numeral is I, charge is +1
  - If the roman numeral is II, charge is +2
  - If the roman numeral is III, charge is +3, etc.

- Write the cation name with the charge as Roman numerals in parenthesis.
- Ends in “ide”
- EXCEPTIONS…:

Zn^{2+}, Cd^{2+}, Ag^{1+}

We use Roman Numerals to indicate the charge.

I=1

II=2

III=3

IV=4

V=5

Common Type II Cations

TABLE 4.2

Common Type II Cations

Ion	Systematic Name	Older Name
Fe^{3+}	iron(III)	ferric
Fe^{2+}	iron(II)	ferrous
Cu^{2+}	copper(II)	cupric
Cu^{+}	copper(I)	cuprous
Co^{3+}	cobalt(III)	cobaltic
Co^{2+}	cobalt(II)	cobaltous
Sn^{4+}	tin(IV)	stannic
Sn^{2+}	tin(II)	stannous
Pb^{4+}	lead(IV)	plumbic
Pb^{2+}	lead(II)	plumbous
Hg^{2+}	mercury(II)	mercuric
Hg_2^{2+}*	mercury(I)	mercurous

*Mercury(I) ions always occur bound together in pairs to form Hg_2^{2+}.

Practice

Give the names for each of the following compounds:

- CuCl

  What is the charge on the Cl?

  -1;

  copper(I)chloride

- HgO

  What is the charge on the O?

  -2;

  mercury (II) oxide

-

- Fe_2O_3 Undo the crisscross.
- Fe_2O_3

  Fe^{3+} O^{2-};

  Iron (III) oxide
- MnO_2 Undo the crisscross.

  Mn^{4+} O^{2-}

Manganese (IV) oxide

Practice:

$PbCl_4$

FeO

$CuCl_2$

- Determine the molecular formula
- lead (II) oxide

  $Pb^{2+} + O^{2-} \longrightarrow PbO$ *(do the charges add to 0?)*

  +2 + -2 = 0
- Iron (III) sulfide

  $Fe^{3+} + S^{2-} \longrightarrow Fe_2S_3$

  (crisscross)

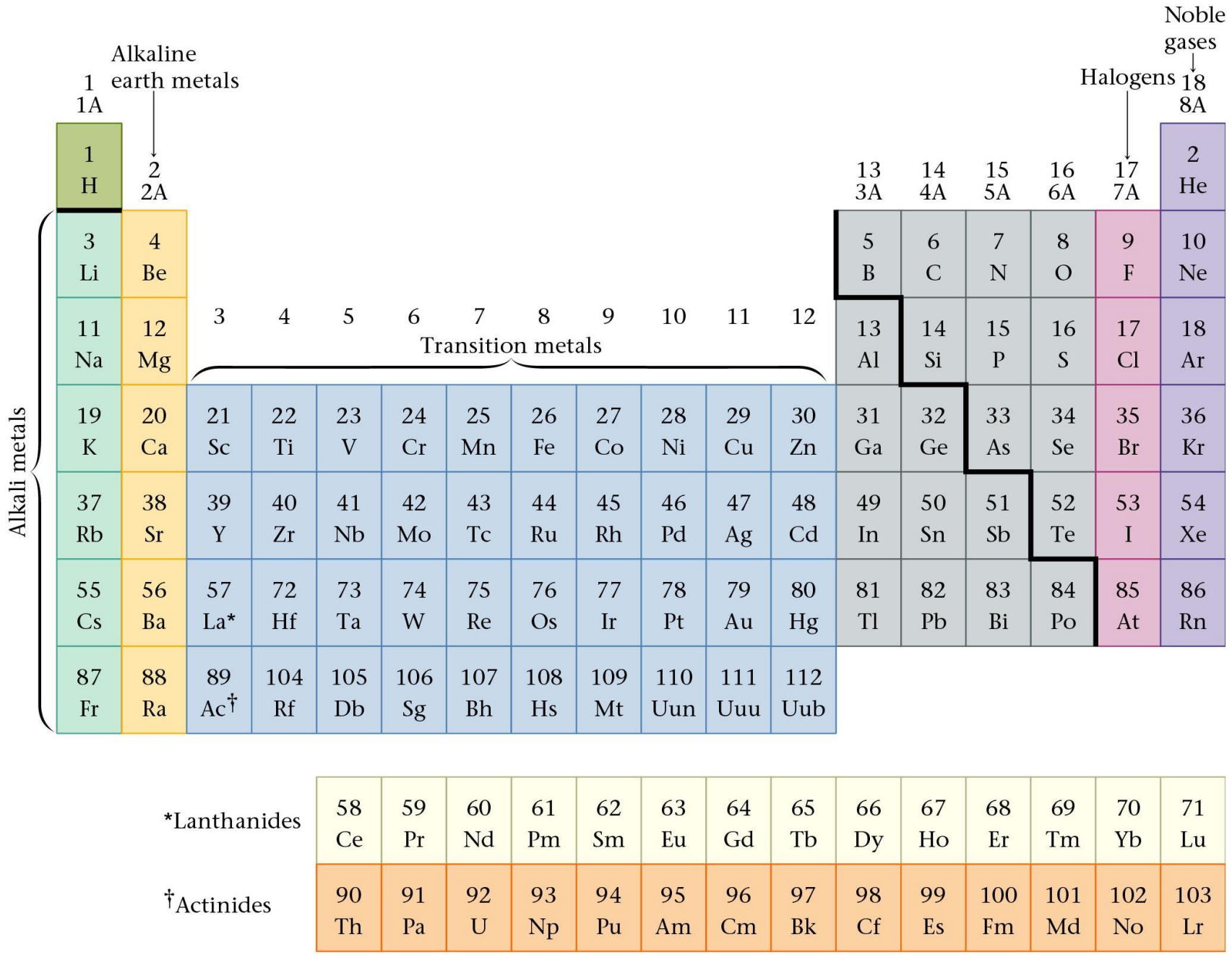
- Copper (II) Nitride

  $Cu^{2+} + N^{3-} \longrightarrow Cu_3N_2$

  (crisscross)

1. K_2O
2. Li_2SO_4
3. $Sn(NO_3)_4$
4. NH_4Br
5. $CrBr_3$
6. Nickel (II) chloride
7. Copper (I) nitrate
8. Ammonium sulfite
9. Magnesium nitride
10. Iron (III) phosphide
11. Ammonium phosphate

TYPE III
BINARY COMPOUNDS THAT ONLY CONTAIN NONMETALS (MOLECULAR)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25 Mn
26 Fe
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28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
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34 Se
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- Forms between 2 or more nonmetals
- Ionic charges are NOT used
- Can be multiple combinations of the same atoms ex. CO & CO_2

Rules for naming

1. The first element in the formula is named first
2. The second element is named as though it were an anion. (ends in –ide)
3. Prefixes are used to denote the numbers of atoms present.
4. The prefix mono- is never used for naming the first element. For example, CO is carbon monoxide, never monocarbon monoxide.

Number of atoms	Prefix
1	mono-
2	di-
3	tri-
4	tetra-
5	penta-
6	hexa-
7	hepta-
8	octa-
9	nona-
10	deca-

MEMORIZE THESE!!!!!

- Examples:

  CO= carbon monoxide

  CO_2=

  carbon dioxide

  N_2O_5 =

  dinitrogen pentoxide

  carbon tetrachloride =

  CCl_4

  dihydrogen monoxide =

  H_2O

Memorize: NH_3 = ammonia

Remember ammonium? **NH_4^+**

Practice

- Name these Type III Binary Compounds:

  BF_3

  NO

  N_2O_3

  CCl_4

  IF_5

ACIDS

- A substance that produces a hydrogen ion in solution *HINT: look for <u>H</u> in the front of the formula*
- 3 types of names

#1- comes from binary compound ending in "-ide"

- change to **hydro_____ic acid**

HCl= hydrogen chloride rename as **hydrochloric acid**

H_3N= trihydrogen nitride rename as **hydronitric acid**

H_2S= dihydrogen sulfide rename as **hydrosulfic acid**

#2-comes from polyatomic ion ending in “-ite”

- Change to **“ous” acid**

HNO_2=hydrogen nitrite rename as **nitrous acid**

H_2SO_3= dihydrogen sulfite rename **sulfurous acid**

#3 comes from polyatomic ion ending in “-ate”

– Change to **–ic acid**

HNO_3= hydrogen nitrate rename as **nitric acid**

H_2SO_4= dihydrogen sulfate rename as **sulfuric acid**

Rule # 2 & 3 Examples

Acid	Anion	Name
H_2SO_4	SO_4^{2-} (sulfate)	sulfuric acid
H_3PO_4	PO_4^{3-} (phosphate)	phosphoric acid
$HC_2H_3O_2$	$C_2H_3O_2^-$ (acetate)	acetic acid
H_2SO_3	SO_3^{2-} (sulfite)	sulfurous acid
HNO_2	NO_2^- (nitrite)	nitrous acid

Practice

- Name the following acids

  HI

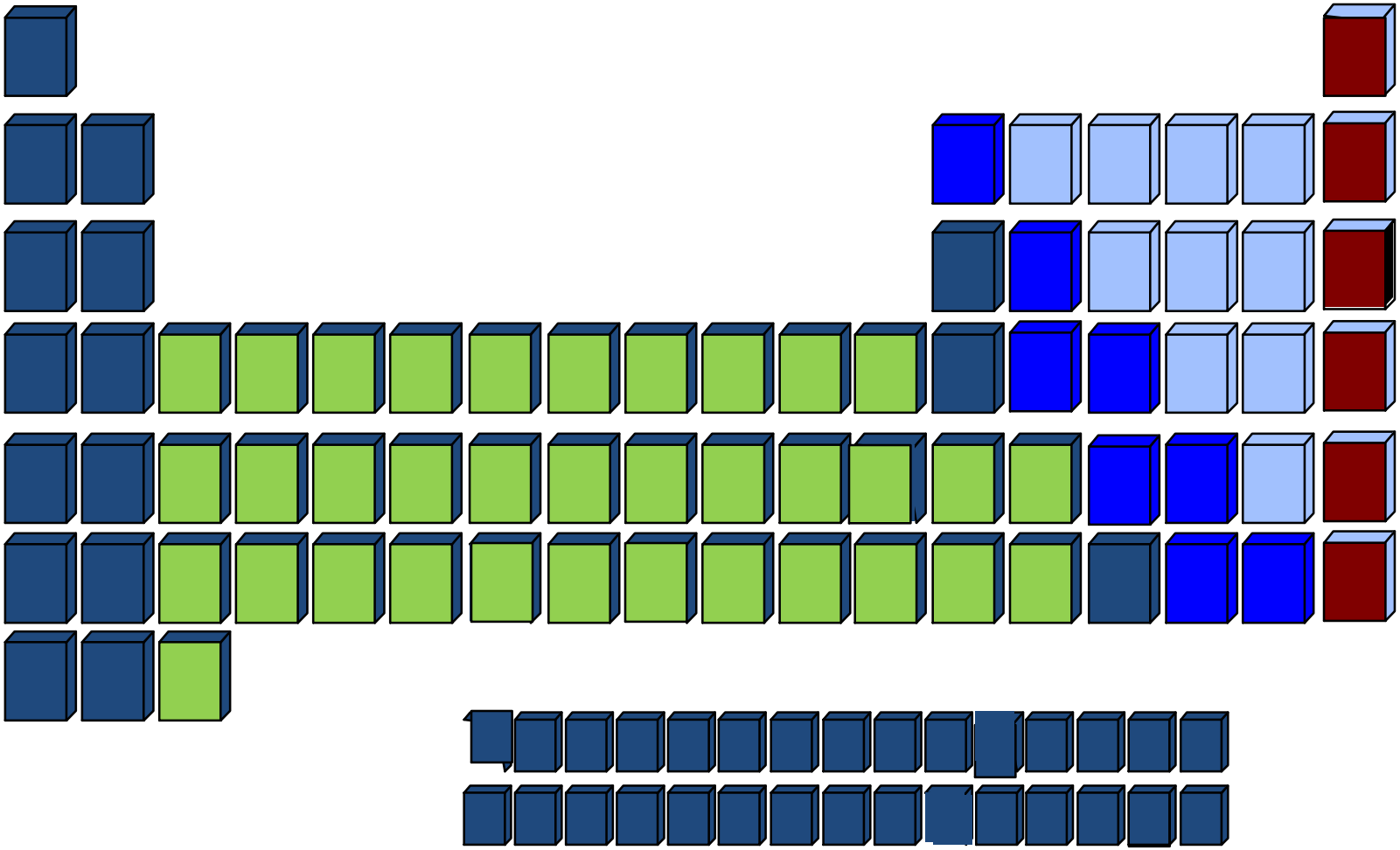
  HBr

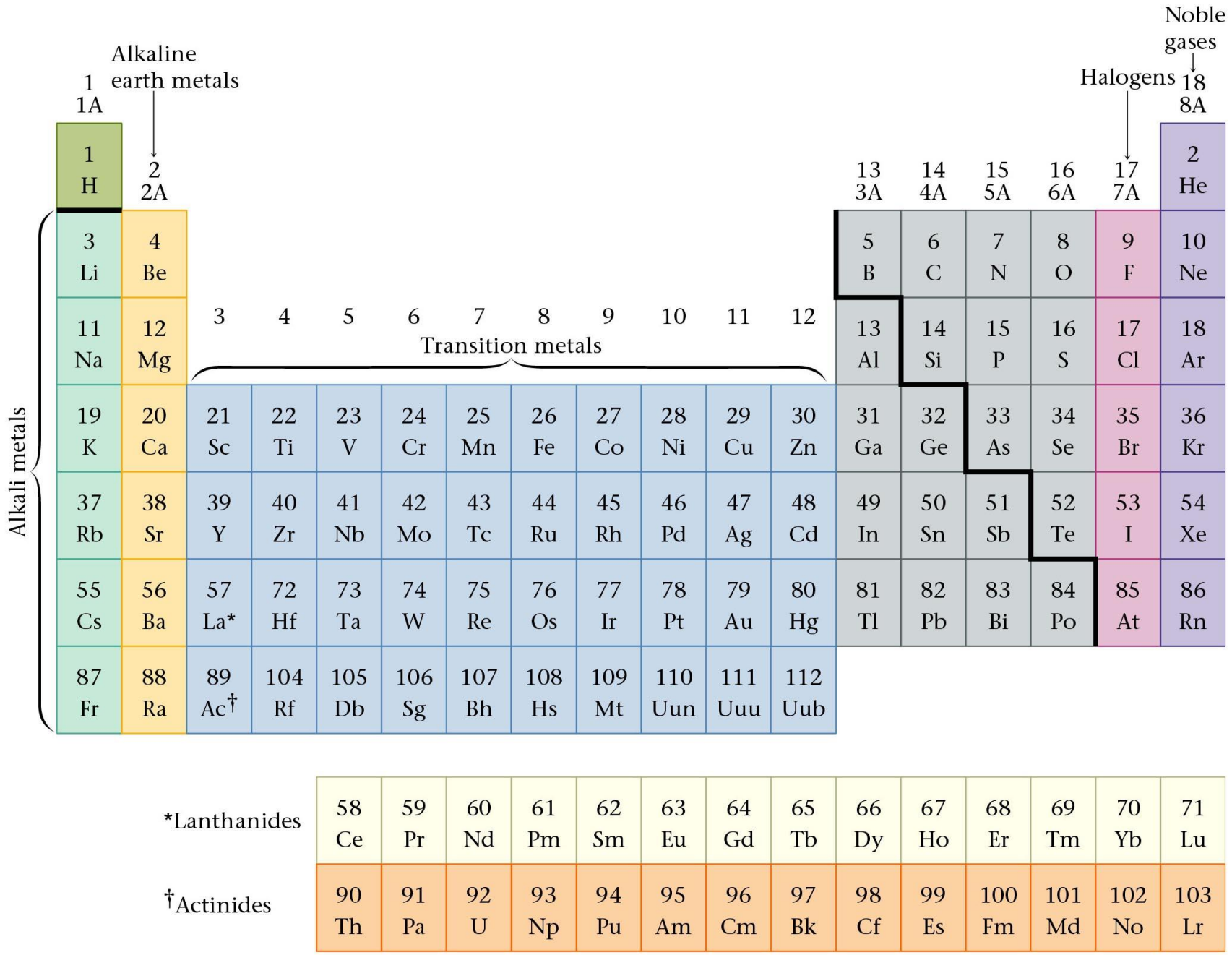
  HCN

  H_2S

  HF

  HNO_3

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