

Review 5

A- Nomenclature and chemical formula

Identify the Type of Bond

Ionic

electrons transferred



cation & anion



(metal) (nonmetal)

☆ magnetic attraction

☆ strongest type of bond

cross charges

cation anion
 first second
 -ide ending

always use
empirical formulas

Transition Metals

use Roman Numerals
Sn & Pb

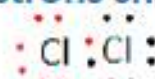
Polyatomic Ions

use parentheses if
cross charge to outside

**NEVER use
prefixes**

Covalent

electrons shared



nonmetal & nonmetal

☆ physically joined

**always use
prefixes**

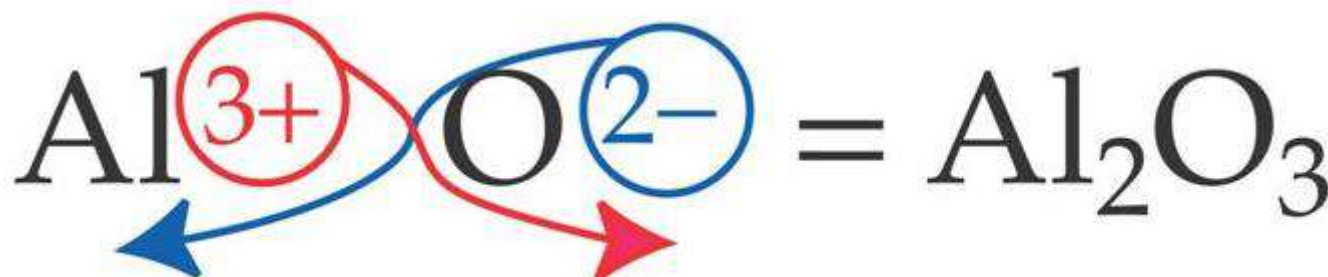
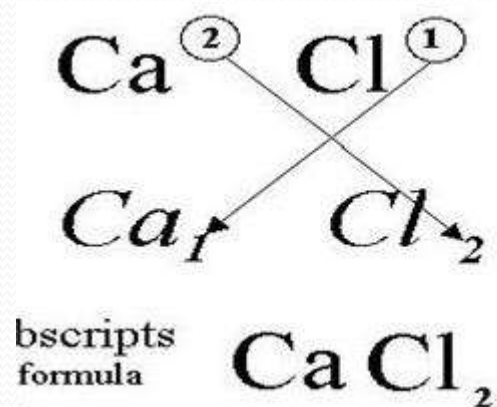
-ide ending on 2nd element

1. mono **never** on 1st element
2. di
3. tri
4. tetra
5. penta
6. hexa
7. hepta
8. octa
9. nona
10. deca

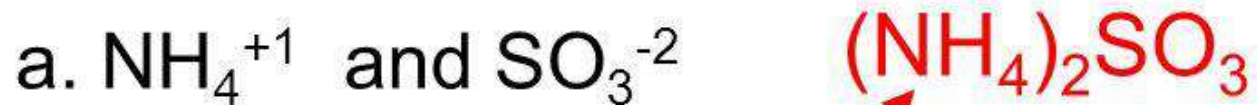
**NEVER
cross
anything!**

**NEVER
use empirical
formulas unless
asked to**

Crossover rule for ionic compounds



#12 Write formulas for compounds formed from these pairs of ions.



Always use parenthesis when you have more than one polyatomic ion (positive or negative) to avoid interpreting it as 42.

b. calcium ion and phosphate ion



Cations of metals from groups 1A, 2A, and 3A have constant charges and do NOT get Roman Numerals in their names

| | | | |
|-----------------------|------------------|------------------|-------------------------|
| a. Barium nitride | Ba^{+2} | N^{-3} | Ba_3N_2 |
| b. Indium Fluoride | In^{+3} | F^{-1} | InF_3 |
| c. Calcium oxide | Ca^{+2} | O^{-2} | CaO |
| d. Sodium nitride | Na^{+1} | N^{-3} | Na_3N |
| e. Magnesium chloride | Mg^{+2} | Cl^{-1} | MgCl_2 |
| f. Potassium oxide | K^{+1} | O^{-2} | K_2O |
| g. Magnesium oxide | Mg^{+2} | O^{-2} | MgO |
| h. Potassium sulfide | K^{+1} | S^{-2} | K_2S |
| i. Lithium nitride | Li^{+} | N^{-3} | Li_3N |
| j. Strontium fluoride | Sr^{+2} | F^{-1} | SrF_2 |
| k. Aluminum sulfide | Al^{+3} | S^{-2} | Al_2S_3 |

Cations of Transition metals and metals from group 4A (Pb and Sn) and metals from group 5A (Bi) get Roman Numerals in their names

| | | |
|----------------------------|----------------------------|-------------------------|
| a. SnO_2 | oxide = O^{-2} | Tin (IV) oxide |
| b. Mn_2O_7 | oxide = O^{-2} | Manganese (VII) oxide |
| c. FeN | nitride = N^{-3} | Iron (III) nitride |
| d. Cu_3N_2 | nitride = N^{-3} | Copper (II) nitride |
| e. TiF_3 | fluoride = F^{-1} | Titanium (III) fluoride |
| f. Cu_2S | sulfide = S^{-2} | Copper (I) sulfide |
| g. Fe_2S_3 | sulfide = S^{-2} | Iron (III) sulfide |
| h. CuBr | bromide = Br^{-1} | Copper (I) bromide |
| i. Co_3N_2 | nitride = N^{-3} | Cobalt (II) nitride |
| j. CoF_2 | fluoride = F^{-1} | Cobalt (II) fluoride |

Nomenclature of multivalent cations

Systematic (new) common (old)

| Symbol | 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 |
| $^*\text{Hg}_2^{2+}$ | Mercury(I) ion | Mercurous ion |
| Hg^{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+} | 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+} | Cobalt(II) ion | Cobaltous ion |
| Co^{3+} | Cobalt(III) ion | Cobaltic ion |

| | | | | | | | | | | | | | | | | | |
|---|------------------------------------|------------------------------------|--|--|--|--|---|--|---|---|---|---|---|---|--|--|--|
| 1 1A | | | | | | | | | | | | | | | | | 18 8A |
| 1 H +1 -1 | | 2 2A | | | | | | | | | | 13 3A | 14 4A | 15 5A | 16 6A | 17 7A | 2 He |
| 3 Li +1 | 4 Be +2 | | | | | | | | | | | 5 B +3 | 6 C +4 -4 | 7 N +5 +4 +3 +2 +1 -3 | 8 O +2 -1 -2 | 9 F -1 | 10 Ne |
| 11 Na +1 | 12 Mg +2 | | | | | | | | | | | 13 Al +3 | 14 Si +4 -4 | 15 P +5 +3 -3 | 16 S +6 +4 -2 | 17 Cl +7 +6 +5 +4 +3 +1 -1 | 18 Ar |
| | | 3 3B | 4 4B | 5 5B | 6 6B | 7 7B | 8 8B | 9 8B | 10 8B | 11 1B | 12 2B | | | | | | |
| 19 K +1 | 20 Ca +2 | 21 Sc +3 | 22 Ti +4 +3 +2 | 23 V +5 +4 +3 +2 | 24 Cr +6 +5 +4 +3 +2 | 25 Mn +7 +6 +4 +3 +2 | 26 Fe +3 +2 | 27 Co +3 +2 | 28 Ni +2 | 29 Cu +2 +1 | 30 Zn +2 | 31 Ga +3 | 32 Ge +4 -4 | 33 As +5 +3 -3 | 34 Se +6 +4 -2 | 35 Br +5 +3 +1 -1 | 36 Kr +4 +2 |
| 37 Rb +1 | 38 Sr +2 | 39 Y +3 | 40 Zr +4 | 41 Nb +5 +4 | 42 Mo +6 +4 +3 | 43 Tc +7 +6 +4 | 44 Ru +8 +6 +4 +3 | 45 Rh +4 +3 +2 | 46 Pd +4 +2 | 47 Ag +1 | 48 Cd +2 | 49 In +3 | 50 Sn +4 +2 | 51 Sb +5 +3 -3 | 52 Te +6 +4 -2 | 53 I +7 +5 +1 -1 | 54 Xe +6 +4 +2 |
| 55 Cs +1 | 56 Ba +2 | 57 La +3 | 72 Hf +4 | 73 Ta +5 | 74 W +6 +4 | 75 Re +7 +6 +4 | 76 Os +8 +4 | 77 Ir +4 +3 | 78 Pt +4 +2 | 79 Au +3 +1 | 80 Hg +2 +1 | 81 Tl +3 +1 | 82 Pb +4 +2 | 83 Bi +5 +3 | 84 Po +2 | 85 At -1 | 86 Rn |

Figure 4.10

Oxidation numbers of elements in their compounds. The more common oxidation numbers are in color.

Ionic Compounds with Polyatomic Ions

- | | |
|---------------------------------|-----------------------|
| a. $\text{Co}(\text{NO}_3)_2$ | Cobalt (II) nitrate |
| b. NaNO_2 | Sodium nitrite |
| c. $\text{Cu}_3(\text{PO}_3)_2$ | Copper (II) phosphite |
| d. $\text{Ba}(\text{CN})_2$ | Barium cyanide |
| e. $\text{Al}_2(\text{SO}_4)_3$ | Aluminum sulfate |
| f. KClO_3 | Potassium chlorate |

2.73 Fill the blanks in the following table.

| Cation | Anion | Formula | Name |
|--------------------|--------------------|--------------------------|------------------------|
| | | | Magnesium bicarbonate |
| | | SrCl_2 | |
| Fe^{3+} | NO_2^- | | |
| | | | Manganese(II) chlorate |
| | | SnBr_4 | |
| Co^{2+} | PO_4^{3-} | | |
| Hg_2^{2+} | I^- | | |
| | | Cu_2CO_3 | |
| | | | Lithium nitride |
| Al^{3+} | S^{2-} | | |

Binary Covalent Compounds

- a. CO Carbon monoxide
- b. CO_2 Carbon dioxide
- c. NO Nitrogen monoxide
- d. NO_2 Nitrogen dioxide
- e. SF_6 Sulfur hexafluoride
- f. SiF_4 Silicon tetrafluoride

Note

- HCl Hydrogen chloride
- SiC Silicon carbide
- HBr Hydrogen bromide

Determine whether the compound is ionic or covalent and give the name:

| | Ionic/Covalent/Acid? | Name |
|-----------------------------|----------------------|------------------------------|
| 1) Na_2CO_3 | Ionic | Sodium carbonate |
| 2) NaOH | Ionic | Sodium hydroxide |
| 3) MgBr_2 | Ionic | Magnesium bromide |
| 4) P_4S_5 | Covalent | Tetraphosphorus pentasulfide |
| 6) O_2 | Covalent | Oxygen |
| 7) FeCl_2 | Ionic | Iron (II) chloride |
| 8) FeCl_3 | Ionic | Iron (III) chloride |
| 9) SeF_6 | Covalent | Selenium hexafluoride |
| B_2Si | Covalent | Diboron silicide |
| Al_2S_3 | Ionic | Aluminum sulfide |
| NCl_3 | Covalent | Nitrogen trichloride |
| PbO | Ionic | Lead (II) oxide |

Ionic bonding: Lattice energy

| Compound | Lattice Energy (kJ mol ⁻¹) | Compound | Lattice Energy (kJ mol ⁻¹) |
|----------|---|-------------------|---|
| NaF | 910 | MgCl ₂ | 2326 |
| NaCl | 787 | SrCl ₂ | 2127 |
| NaBr | 732 | | |
| NaI | 682 | MgO | 3795 |

Some Bond Enthalpies of Diatomic Molecules

• A

| Bond | Bond Enthalpy (kJ/mol) |
|------|------------------------|
|------|------------------------|

| | |
|-------|-------|
| H — F | 568.2 |
|-------|-------|

| | |
|--------|-------|
| H — Cl | 431.9 |
|--------|-------|

| | |
|--------|-------|
| H — Br | 366.1 |
|--------|-------|

| | |
|-------|-------|
| H — I | 298.3 |
|-------|-------|

• B

| | |
|---------|-------|
| Cl — Cl | 242.7 |
|---------|-------|

| | |
|---------|-------|
| Br — Br | 192.5 |
|---------|-------|

| | |
|-------|-------|
| I — I | 151.0 |
|-------|-------|

• C

| | |
|-------|-------|
| H — H | 436.4 |
|-------|-------|

| | |
|-------|-------|
| O = O | 498.7 |
|-------|-------|

| | |
|-------|-------|
| N ≡ N | 941.4 |
|-------|-------|



To be continued