KEY

Simple Ionic Compounds
Naming

- Simple ionic compounds are composed of a metal and a non-metal.
- Ionic bonds involve the transfer of electrons from one atom to another, creating ions.

RULES:
1. Metallic element is always named first.
2. Non-metallic element named second (lower case), and its ending is changed to "ide".

Example:

CaF_2	Calcium fluoride
Na_2O	sodium oxide

Practice:

Name the compound formed by:

1. Na and Cl sodium chloride
2. K and I potassium iodide
3. Ca and C calcium carbide
4. N and Mg magnesium nitride
5. O and Ba barium oxide
6. Al and I aluminum iodide
7. S and Ba barium sulphide
8. Al and P aluminum phosphide
9. Br and Ba barium bromide
10. K and O potassium oxide

Name the following compounds:

1. NaF sodium fluoride
2. K_2O potassium oxide
3. Ca_3N_2 calcium nitride
4. $BaCl_2$ barium chloride
5. Na_2S sodium sulphide
6. Ca_3P_2 calcium phosphide
7. K_3P potassium phosphide
8. BaI_2 barium iodide
9. Al_2O_3 aluminum oxide
10. Na_4C sodium carbide
11. AlP aluminum phosphide
12. NaI sodium iodide
13. KBr potassium bromide
14. AlF_3 aluminum fluoride
15. BaO barium oxide
16. K_3N potassium nitride

Simple Ionic Compounds
Writing Formulae

- Writing formulae for simple ionic compounds requires that you know the combining capacity of the elements involved.

RULES:
1. Write the symbol and the combining capacity for the metallic element first.
2. Write the symbol and the combining capacity for the non-metallic element second.
3. Criss-cross the combining capacities and reduce to the lowest common multiple.

Example:

Name	Criss-cross	Formula	Simplify
Calcium nitride	Ca^{+2} N^{-3}	Ca_3N_2	
Magnesium oxide	Mg^{+2} O^{-2}	Mg_2O_2	MgO

Practice:

Give the formula for the following:

1. Sodium iodide NaI
2. Potassium oxide K_2O
3. Barium nitride Ba_3N_2
4. Francium sulphide Fr_2S
5. Cesium phosphide Cs_3P
6. Lithium fluoride LiF
7. Beryllium ~~carbide~~ sulphide BeS
8. Strontium selenide SrSe
9. Rubidium telluride Rb_2Te
10. Radium phosphide Ra_3P_2
11. Calcium chloride $CaCl_2$
12. Magnesium sulphide MgS
13. Potassium bromide KBr
14. Aluminum oxide Al_2O_3
15. Zinc chloride $ZnCl_2$
16. Potassium nitride K_3N

Multi-valent Metals / Transition Metals
Naming

- Many transition metals, found in the centre block of the periodic table, have more than one possible combining capacity.
- They are therefore called multi-valent.

RULES:
1. Metallic element is always named first, followed by the combining capacity being used in Roman Numerals.
2. Non-metallic element named second (lower case), and its ending is changed to "ide".

Example:

Fe_2O_3	Iron (III) oxide
Nb_2O_5	Niobium (V) oxide

Hint: "Un-criss-crossing" the combining capacities may help!

Practice:

Name the following compounds:

1. CuO Copper II oxide
2. $CrCl_3$ chromium III chloride
3. MoS molybdenum II sulphide
4. Tc_2O_7 technetium oxide
5. $CoCl_2$ cobalt II chloride
6. PtS_2 platinum IV sulphide
7. Tl_2O_3 thallium III oxide
8. $CuCl_2$ copper II chloride
9. $AuCl_3$ gold III chloride
10. $CrBr_3$ chromium III bromide
11. TiN titanium III nitride
12. SnF_4 tin (IV) fluoride
13. Pb_3N_4 lead IV nitride
14. Cu_2S copper I sulphide
15. Pd_3As_2 palladium II arsenide
16. IrO_2 iridium IV oxide

Multi-valent Metals / Transition Metals
Writing Formulae

- The only difference between these compounds and other ionic compounds is that the combining capacity of the metal is given to you in Roman Numerals following the name of the metal.

RULES:
1. Write the symbol and the combining capacity for the metallic element first.
2. Write the symbol and the combining capacity for the non-metallic element second.
3. Criss-cross the combining capacities and reduce to the lowest common multiple.

Example:

Name	Criss-cross	Formula	Simplify
Gold (III) oxide	Au^{+3} O^{-2}	Au_2O_3	
Chromium (II) sulphide	Cr^{+2} S^{-2}	Cr_2S_2	CrS

Practice:

Give the formula for the following:

1. Manganese (IV) oxide MnO_2
2. Cobalt (III) ~~boride~~ nitride CoN
3. Palladium (IV) bromide $PdBr_4$
4. Osmium (III) selenide Os_2Se_3
5. ~~Tungsten~~ Plutonium (VI) sulphide PuS_3
6. Rhenium (VII) arsenide Re_3As_7
7. Mercury (II) oxide HgO
8. Polonium (IV) astatide $PoAt_4$
9. Thallium (III) phosphide TlP
10. Antimony (V) telluride Sb_2Te_5
11. Lead (IV) oxide PbO_2
12. Cobalt (II) chloride $CoCl_2$
13. Nickel (III) sulphide Ni_2S_3
14. Niobium (V) phosphide Nb_3P_5

Polyatomic Ions
Naming

- Polyatomic ions are groups of tightly bound atoms with an overall ionic charge that behave as if they were a single metallic or non-metallic ion during chemical changes.

TABLE 2.3 Some Common Polyatomic Ions

Formula	Name	Formula	Name
Cation		*Singly charged anions (continued)*	
NH_4^+	Ammonium	NO_2^-	Nitrite
Singly charged anions		NO_3^-	Nitrate
$CH_3CO_2^-$	Acetate	*Doubly charged anions*	
CN^-	Cyanide	CO_3^{2-}	Carbonate
ClO^-	Hypochlorite	CrO_4^{2-}	Chromate
ClO_2^-	Chlorite	$Cr_2O_7^{2-}$	Dichromate
ClO_3^-	Chlorate	O_2^{2-}	Peroxide
ClO_4^-	Perchlorate	HPO_3^{2-}	Hydrogen phosphate
$H_2PO_4^-$	Dihydrogen phosphate	SO_3^{2-}	Sulfite
HCO_3^-	Hydrogen carbonate (or bicarbonate)	SO_4^{2-}	Sulfate
		$S_2O_3^{2-}$	Thiosulfate
HSO_4^-	Hydrogen sulfate (or bisulfate)	*Triply charged anion*	
OH^-	Hydroxide	PO_4^{3-}	Phosphate
MnO_4^-	Permanganate		

RULES:
1. Follow regular naming rules except that the name of the polyatomic ion is never changed.

Example:

$Mg(NO_3)_2$	Magnesium nitrate
NH_4Cl	Ammonium chloride
$Pb(NO_3)_2$	Lead (II) nitrate

Practice:
Name the following compounds:

1. $NaOH$ Sodium hydroxide
2. $CaCO_3$ calcium carbonate
3. $KClO_3$ potassium chlorate
4. $NaHCO_3$ sodium bicarbonate
5. $AlPO_4$ aluminum prosplate
6. $AuClO_3$ gold (I) chlorate
7. $NiPO_4$ nickel III phosphate
8. $K_2Cr_2O_7$ potassium dichromate
9. $NaHSO_4$ sodium bisulphate
10. NH_4Br ammonium bromide
11. Na_2SO_4 sodium sulphate
12. $Ba(OH)_2$ barium hydroxide
13. $Fe(NO_2)_3$ iron III nitrite
14. $(NH_4)_2O$ ammonium oxide
15. $MgSO_4$ magnesium sulphate
16. $CuSO_4$ Copper II sulphate

Polyatomic Ions
Writing Formulae

- Writing formulae for these compounds is not much different than writing formulae for regular ionic compounds. The rules are basically the same with a few additions.

RULES:
1. Write the symbol and the combining capacity for the metallic element first or the polyatomic ion ammonium if present.
2. Write the symbol and the combining capacity for the negative polyatomic ion second.
3. Criss-cross the combining capacities and reduce to the lowest common multiple.
4. Remember to use brackets if there is more than one group of the polyatomic ion.

Example:

Name	Criss-cross	Formula
Ammonium nitride	NH_4^{+1} N^{-3}	$(NH_4)_3N$
Sodium carbonate	Na^{+1} CO_3^{-2}	Na_2CO_3

Practice:

Give the formula for the following:

1. Cadmium nitrate $Cd(NO_3)_2$
2. Strontium phosphate $Sr_3(PO_4)_2$
3. Ammonium sulphide $(NH_4)_2S$
4. Magnesium chlorate $Mg(ClO_3)_2$
5. Barium sulphate $BaSO_4$
6. Cesium bicarbonate $CsHCO_3$
7. Calcium hydroxide $Ca(OH)_2$
8. Ammonium dichromate $(NH_4)_2Cr_2O_7$
9. Lithium carbonate Li_2CO_3
10. Aluminum bisulphate $Al(HSO_4)_3$
11. Lead (IV) sulphite $Pb(SO_3)_2$
12. Cobalt (III) cyanide $Co(CN)_3$
13. Chromium (VI) acetate $Cr(CH_3COO)_6$
14. Ammonium phosphate $(NH_4)_3PO_4$

Hydrates
Naming & Formulae

- hydrates are molecules which include water molecules in their crystal structure
- they are created when a crystal of an ionic compound is grown by evaporation from an aqueous solution
- name the compound as normal then add a prefix to describe how many water molecules are attached with the word "hydrate"

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

ex. $CuSO_4 \cdot 5H_2O$ = copper (II) sulphate pentahydrate
$Zn(CH_3COO)_2 \cdot 2H_2O$ = zinc acetate dihydrate

✦ Name the following hydrated compounds:

a. $FeBr_3 \cdot 6H_2O$ iron III bromide · hexahydrate
b. $Li_2Cr_2O_7 \cdot 2H_2O$ lithium dichromate · dihydrate
c. $Al_2O_3 \cdot 3H_2O$ aluminum oxide · trihydrate
d. $CoF_2 \cdot 4H_2O$ cobalt II fluoride · tetrahydrate
e. $Na_2CO_3 \cdot H_2O$ sodium carbonate · monohydrate

✦ Write the formula for the following hydrated compounds:

a. iron (III) phosphate octahydrate $FePO_4 \cdot 8H_2O$
b. cadmium (II) nitrate tetrahydrate $Cd(NO_3)_2 \cdot 4H_2O$
c. copper (II) phosphate trihydrate $Cu_3(PO_4)_2 \cdot 3H_2O$
d. chromium (II) oxalate monohydrate $CrC_2O_4 \cdot H_2O$
e. aluminum nitrate nonahydrate $Al(NO_3)_3 \cdot 9H_2O$