

Nomenclature Rules & Worksheet

1. Ionic Compounds = Fixed Charge Metal + Nonmetal

- Ionic compounds are named by using the metal's name + the nonmetal's name cut off short + the suffix "ide"
- NaCl is sodium chloride, Li₂O is lithium oxide, KBr is potassium bromide, MgI₂ is magnesium iodide, sodium nitride is Na₃N, calcium bromide is CaBr₂, aluminum fluoride is AlF₃
- Note that ionic compounds are always "reduced" formulas - we would never say that table salt is Na₆Cl₆ but NaCl so it is reduced to the lowest number kinda like a fraction would be reduced

-----Ionic compounds with polyatomic ions

- Treat the polyatomic ion as a group – keep it together as a group, never change the name of the polyatomic ion - they are listed on your Periodic Table by the way ☺
- Name it by using the metal's name followed by the polyatomic ion's name
- NaOH is sodium hydroxide, Ca(NO₃)₂ is calcium nitrate, MgSO₄ is magnesium sulfate, ammonium sulfide is (NH₄)₂S, calcium carbonate is CaCO₃, magnesium phosphate is Mg₃(PO₄)₂

2. Ionic compounds = Variable Charge Metal + Nonmetal (or polyatomic ion)

- Name these by using the metal's name then (charge of metal in Roman numerals) + name of nonmetal cut short + suffix "ide"
- Fe₂O₃ is iron(III) oxide, CuS is copper(II) sulfide, Co(NO₃)₃ is cobalt(III) nitrate, FeSO₄ is iron(II) sulfate, iron(III) fluoride is FeF₃, iron(II) phosphate is Fe₃(PO₄)₂
- The CHARGE of the transition metal is in () not how many there are

3. Covalent or Molecular Compounds = Nonmetals only

- Name covalent compounds with two nonmetals by using a prefix + nonmetal's name + prefix + 2nd nonmetal's name cut off short + suffix "ide"
- Prefixes are mono, di, tri, tetra, penta, hexa, hepta, octa
- If there is only one of the first nonmetal, don't use the mono prefix, never start a name with mono
- Carbon tetraiodide is CI₄, sulfur dioxide is SO₂, phosphorus pentachloride is PCl₅, P₂O₅ is diphosphorus pentoxide, N₂H₄ is dinitrogen tetrahydride, SF₂ is sulfur difluoride

Charges and Ionic Formulas

Here are some rules about charges.

- Alkali metals are **always** charged +1 when in a compound. Their goal is to lose one electron, thus becoming +1 cations.
- Alkaline Earth metals are **always** charged +2 when in a compound. Their goal is to lose two electrons, thus becoming +2 cations.
- B column is usually charged +3 depending on what they are bonded to. They can lose 3 electrons becoming +3. NOTE that Al, Ga and In are **always** +3.
- C column is usually charged +4 or -4 depending on what it is bonded to. They can lose 4 electrons becoming +4 OR gain 4 electrons becoming -4. (They can sometimes also be +2 or -2.)

- N column is usually charged -3 in ionic compounds but the metals Sb and Bi are often +5. They can lose 5 electrons becoming +5 OR gain 3 electrons becoming -3. Example Na_3N N is -3 and Na is +1.
- O Column are usually charged -2 in compounds
- Halogens are usually charged -1 in compounds (F **always** is -1)
- Noble gases are stable and unreactive, - they are neutral atoms with NO charge.
- The other metals have many charges, too many to predict. Exceptions are Zn and Cd which are **always** +2 and silver which is **always** +1. Dr. Kim's research focused on Re which can be charged from +1 all the way up to +9.
- The nonmetal H is usually +1 in an ionic compound.
- Remember the atoms in a **pure element have a charge of ZERO!!!** Atoms don't have charges unless they are bonded to something else or have lost or gained electrons. Na(s) , $\text{O}_2(\text{g})$, $\text{Br}_2(\text{l})$ are all charge 0.

Questions

I. OK, what is the chemical formula and name of the following when combined???

1. lithium and oxygen
2. magnesium and phosphate ion
3. ammonium and sulfur
4. calcium and fluorine
5. aluminum and chlorine
6. potassium and nitrate ion
7. sodium and sulfate ion
8. calcium and hydroxide ion
9. silver and carbonate ion
10. sodium and bromine
11. copper(II) and sulfur
12. nickel(III) and carbonate ion
13. Just name CO_2 , N_2O , Cl_4 , and PCl_5

II. What are the names of the following chemicals?

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|-------------------|---------------------------------|-----------------------------|--|
| 1. KF | 4. P_2S_5 | 7. CaF_2 | 10. $\text{NaC}_2\text{H}_3\text{O}_2$ |
| 2. MgI_2 | 5. $\text{Au}_2(\text{SO}_3)_3$ | 8. $\text{Co}(\text{OH})_3$ | |
| 3. FeO | 6. SiCl_4 | 9. SO_2 | |

III. What are the formulas of the following chemicals?

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|---------------------------|-----------------------|------------------------|
| 1. lithium carbonate | 5. calcium sulfate | 9. mercury(II) bromide |
| 2. nickel(II) nitrate | 6. copper(II) sulfide | 10. carbon disulfide |
| 3. dihydrogen dioxide | 7. silver chloride | |
| 4. dihydrogen monosulfide | 8. zinc hydroxide | |

Answers

1. Li_2O (Li is +1 so we need 2 of them since O is -2) lithium oxide
2. $\text{Mg}_3(\text{PO}_4)_2$ (Mg is +2 so we need 3 of them, phosphate is -3 so we need 2 of them) magnesium phosphate
3. $(\text{NH}_4)_2\text{S}$ (ammonium is +1 so we need 2 of them since S is -2) ammonium sulfide
4. CaF_2 (Ca is +2 and F is -1 so we need two F) calcium fluoride
5. AlCl_3 (Al is +3 and Cl is -1 so we need 3 of them) aluminum chloride
6. KNO_3 (K is +1 and nitrate is -1) potassium nitrate
7. Na_2SO_4 (Na is +1 so we need 2 of them since sulfate is -2) sodium sulfate
8. $\text{Ca}(\text{OH})_2$ (Ca is +2 and OH is -1 so we need 2 of them) calcium hydroxide
9. Ag_2CO_3 (Ag is +1 so we need 2 of them since carbonate is -2) silver carbonate because we KNOW that silver is always +1 so for this exception we don't need the () in the name
10. NaBr (Na is +1 and Br is -1) sodium bromide
11. CuS (Cu is +2 and S is -2) copper(II) sulfide
12. $\text{Ni}_2(\text{CO}_3)_3$ (Ni is +3 and CO_3 is -2) nickel(III) carbonate
13. carbon dioxide, dinitrogen monoxide, carbon tetraiodide, phosphorus pentachloride

II. Answers

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|------------------------------|--------------------------|
| 1. potassium fluoride | 6. silicon tetrachloride |
| 2. magnesium iodide | 7. calcium fluoride |
| 3. iron(II) oxide | 8. cobalt(III) hydroxide |
| 4. diphosphorus pentasulfide | 9. sulfur dioxide |
| 5. gold(III) sulfite | 10. sodium acetate |

III. Answers

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|-------------------------------|-------------------------|-----------------------------|-------------------|
| 1. Li_2CO_3 | 4. H_2S | 7. AgCl | 10. CS_2 |
| 2. $\text{Ni}(\text{NO}_3)_2$ | 5. CaSO_4 | 8. $\text{Zn}(\text{OH})_2$ | |
| 3. H_2O_2 | 6. CuS | 9. HgBr_2 | |