

Science 1206
Ionic Compounds

Ionic Compounds are made of two ions of opposite charge:

- a positive ion called a cation
- a negative ion called an anion

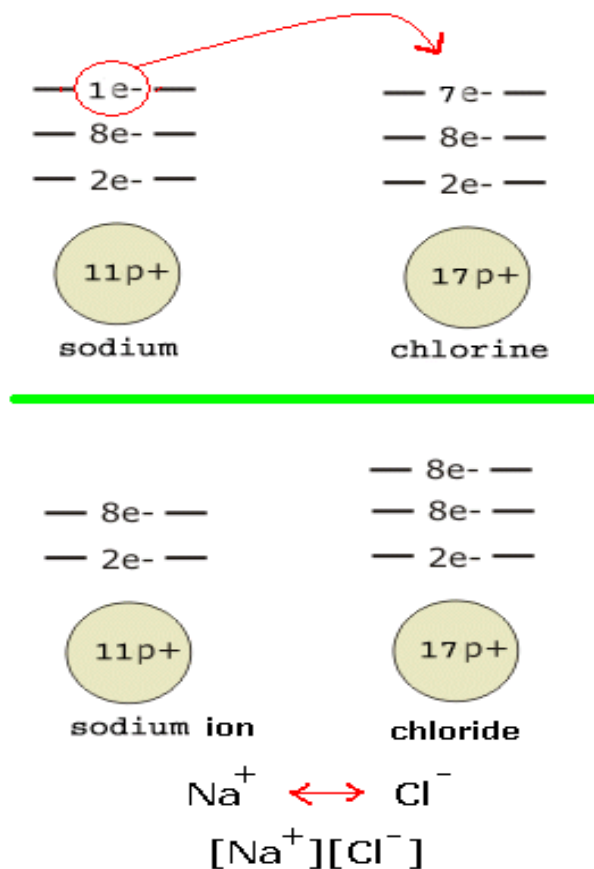
Ions are formed when atoms gain or lose _____.

If an atom gains electrons, it will have a _____ charge and is called a(an) _____.

If an atom loses electrons, it will have a _____ charge and is called a(an) _____.

Ionic compounds are formed when one atom (a metal) loses electrons, which another atom (nonmetal) gains. The two oppositely charged ions attract each other to form an ionic bond.

Example: sodium chloride (table salt) = NaCl



CATIONS: (Positive ions)

Most cations are **metal atoms which have lost electrons**. The charge on each ion can be read directly from the periodic table of ions. (Note: Group IA ions all have a charge of 1+, Group IIA = 2+ and Group IIIA = 3+)

Some metals can form two different ions, and the charge of both ions is written on the periodic table. For example, iron can have a charge of 3+ or 2+, and we call these the iron(II) ion and the iron(III) ion.

A very few cations are made up of two or more atoms combined. These are called complex ions or polyatomic ions. A table of these ions is found on the back of your periodic table. The only polyatomic cation that you will use is ammonium ion - NH_4^+

ANIONS: (Negative Ions)

Many anions are **nonmetal atoms which have gained electrons**. The charge on each ion can be read directly from the periodic table of ions. (Note: Group VA ions all have a charge of 3-, Group VIA = 2- and Group VIIA = 1-)

Many anions are made up of two or more atoms combined. These are called complex ions or polyatomic ions. A table of these ions is found on the back of your periodic table. Some examples are hydroxide ion - OH^- , nitrate ion - NO_3^- , and sulfate - SO_4^{2-} .

Writing Formulas for Ionic Compounds:

- Write the formula for each ion in the name of the compound, cation first.
- Balance the charges on the two ions so that the net charge on the compound is zero. A number (subscript) may need to be written after the formula for one or both ions.
- When using polyatomic ions, a bracket is placed around the formula for the ion if it is followed by any subscript greater than 1.
- Note: Charge switching method may be used. (See textbook)**

- Examples:
- magnesium iodide - Mg^{2+} and $\text{I}^- = \text{MgI}_2$
Two iodide ions are needed to balance one magnesium ion.
 - aluminum nitrate - Al^{3+} and $\text{NO}_3^- = \text{Al}(\text{NO}_3)_3$
Three nitrate ions (charge = 1-) are needed to balance one aluminum ion (charge = 3+)
 - Cobalt(II) phosphate - Co^{2+} and $\text{PO}_4^{3-} = \text{Co}_3(\text{PO}_4)_2$
Three cobalt ions are needed for every two phosphate ions

Naming Ionic Compounds

- Look at the formula for the compound and decide which is the cation and which is the anion.
- Write the name of the cation and the anion (simple anions end in *-ide*)
- If the metal ion can have more than one possible charge, use a roman numeral to show the charge on the metal ion.

- Examples:
- BaSO_4 - $\text{Ba}^{2+} = \text{cation}$ and $\text{SO}_4^{2-} = \text{anion}$
(Barium) (Sulfate)

Therefore $\text{BaSO}_4 = \text{barium sulfate}$

- NH_4OH - $\text{NH}_4^+ = \text{cation}$ and $\text{OH}^- = \text{anion}$
(Ammonium) (Hydroxide)

Therefore $\text{NH}_4\text{OH} = \text{ammonium hydroxide}$

- FeCl_3 - $\text{Fe}^{3+} = \text{cation}$ and $\text{Cl}^- = \text{anion}$
(Iron(III)) (Chloride)

Note: Since iron can have more than one charge, we must name this ion iron(III)

Therefore $\text{FeCl}_3 = \text{iron(III) chloride}$

Ionic Compounds Worksheets

Binary ionic compounds with simple metal ion (cation) and simple negative ion (anion)			
Formula	Cation	Anion	Name
1. SrCl ₂			
2. Al ₂ O ₃			
3. NaBr			
4. Ag ₂ O			
5. K ₂ S			
Name	Cation	Anion	Formula
6. Sodium iodide			
7. Potassium sulfide			
8. Magnesium oxide			
9. Calcium bromide			
10. Aluminum nitride			

Ionic compounds with complex (polyatomic) ion(s).			
Formula	Cation	Anion	Name
11. NaNO ₃			
12. Al(OH) ₃			
13. K ₂ SO ₄			
14. Ca(CH ₃ COO) ₂			
15. CdS ₂ O ₃			
Name	Cation	Anion	Formula
16. Magnesium silicate			
17. Potassium dichromate			
18. Ammonium sulfate			
19. Sodium carbonate			
20. Barium perchlorate			

Ionic compounds with multivalent metallic ions.

Formula	Cation	Anion	Name
21. CuSO ₄			
22. PbO			
23. Fe ₂ O ₃			
24. NiBr ₂			
25. Ti(CrO ₄) ₂			

Name	Cation	Anion	Formula
26. Uranium(IV) oxide			
27. Copper(I) sulfide			
28. Vanadium(V) oxide			
29. Gold(III) chloride			
30. Mercury(II) oxide			

Mixed ionic compounds

Formula	Name	Name	Formula
31. (NH ₄) ₂ S		41. Potassium cyanide	
32. Na ₂ CO ₃		42. Aluminum silicate	
33. K ₃ PO ₄		43. Calcium nitrite	
34. Sb ₂ S ₃		44. Barium oxide	
35. LiOH		45. Lead(IV) carbonate	
36. PbCl ₄		46. Sodium hydrogen sulfide	
37. CsBr		47. Lithium borate	
38. CaSO ₃		48. Copper(II) iodide	
39. Co(ClO ₂) ₂		49. Scandium oxide	
40. KMnO ₄		50. Iron(III) sulfate	