Warm-Up | Nomenclature of Ionic Compounds

Lesson Objectives

By the end of this lesson, you should be able to:

- Predict _____ of stable ionic compounds by balancing charges.
- Name ionic compounds using the International Union of Pure and Applied _____ (IUPAC) nomenclature rules.
- Write chemical formulas of ionic compounds and common polyatomic ions.

Science Practice: Develop vocabulary by using IUPAC rules for naming ionic compounds.

Words to Know

Fill in this table as you work through the lesson. You may also use the glossary to help you.

	an ion that is made up of two or more atoms bonded together, acts as a single unit, and has an overall electric charge
	the rules for naming compounds
	the charge (either positive or negative) that an element is assigned when bonding

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Lesson Question

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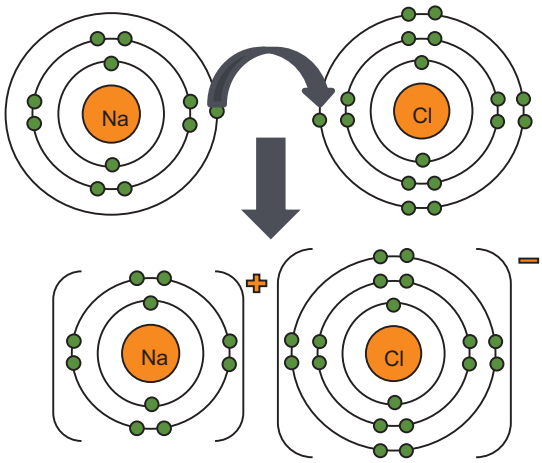
Charge of Ions

_____ **state**: The charge an element is assigned when bonding, either

_____ or negative



Patterns of Ions

The periodic table sheds some light on knowing which oxidation charge an element will have.

- **Metals:** form _____ (positive charge)
  - Group 1: +1
  - Group 2: _____
  - Group 3: +3

- _____**:** form anions (negative charge)
  - Group 16: –2
  - Group 17: _____

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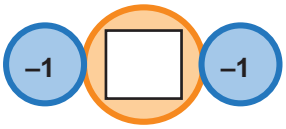
Balancing Charges

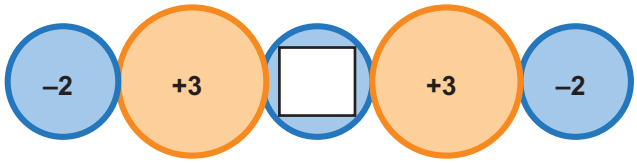
How many –1 ions would ☐ with a +2 ion?

$$(+2) + N(-1) = 0$$
$$N(-1) = -2$$
$$N = \square$$



What is the ratio of +3 ions to –2 ☐ in a neutral compound?

$$M(+3) + N(-2) = 0$$
$$M(3) = N(2)$$
$$M = \square \text{ and } N = \square$$



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Nomenclature of Ionic Compounds

Nomenclature: rules for naming compounds

- Name the cation(s) first, then ☐
- Metal cations: name of metal
- Nonmetal anions: replace ending with *-ide*

- KBr
  - ☐ = potassium
  - Br = bromine
  - Name: ☐ bromide

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Writing Ionic Compound Names

Writing a name from a formula:

- First, identify the cation and write its name as is.
- Second, identify the anion and write its name, but . . .
- replace the ending of the anion with [ ].
- A formula name is written as cation anion.

- $CaCl_2$:
  - Ca = calcium
  - Cl = chlorine
  - Name → calcium [ ]
- Na_2O:
  - Na = [ ]
  - O = oxygen
  - Name → sodium oxide

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Writing Ionic Compound Formulas

Writing a formula from a name:

- Identify cation(s) and charge(s)
- Identify anion(s) and charge(s)
- Balance [ ]
- Write a formula using [ ] symbols and subscripts.

- Magnesium oxide:
  - Mg = +2
  - O = [ ]
  - +2 + (–2) = 0
  - Formula: MgO
- Potassium sulfide
  - K = +1
  - [ ] = –2
  - (2)(+1) + (–2) = 0
  - Formula: [ ]

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Polyatomic Ions

Polyatomic ion: an ion made up of two or more [ ] bonded together that acts as a single unit with an overall electric charge

Name	Formula and charge
Ammonium	NH_4^+
Hydroxide	OH^-
Nitrate	NO_3^-
Carbonate	CO_3^{2-}
	SO_4^{2-}
Phosphate	PO_4^{3-}

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Polyatomic Ions

The following apply to naming and determining [ ] of ionic compounds involving polyatomic ions:

- Polyatomic ions can be cations (written first) or anions (written last).
- Polyatomic ions act as a single unit with [ ] charge, not as individual atoms.
- Use parentheses for multiple polyatomic ions.

Names and Formulas Involving Polyatomic Ions

Writing names from formulas:

- $Ca_3(PO_4)_2$
  - Ca^{2+} = [ ]
  - PO_4^{3-} = phosphate
  - Calcium phosphate
- NH_4OH
  - NH_4^+ = ammonium
  - OH^- = [ ]
  - Ammonium hydroxide

Names and Formulas Involving Polyatomic Ions

Writing formulas from names:

- Sodium phosphate
  - Sodium: Na^+
  - Phosphate: [ ]
  - [ ] $(+1) + (-3) = 0$
  - Na_3PO_4
- Ammonium carbonate
  - Ammonium: NH_4^+
  - Carbonate: [ ]
  - $(2)(+1) + (-2) = 0$
  - $(NH_4)_2CO_3$

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Ionic Compounds with Transition Metals

Let us consider ionic compound nomenclature when transition metals are involved.

- Main group metals: form one kind of ion
- Transition metals: can form ions with different charges
  - *d* and *f* [ ] involved in [ ] configurations
- No real pattern to stable charges
- [ ] numerals used in names to indicate ion charge

Element	Common charges
Ti	+2, +3, +4
V	+2, +3, +4, +5
Cr	+2, +3, +6
Mn	+2, +3, +7
Fe	+2, +3
Co	+2, +3
Ni	+2, +3
Cu	+1, +2
Sn	+2, +4
Pb	+2, +4

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Naming Ionic Compounds with Transition Metals

Example: MnO

- Identify transition and main-group elements.
  - [ ] = transition metal, O = main-group [ ]
- Use charge balance to determine charge on transition metal.

  Mn = [ ] O = –2
- Write name as usual, using roman numerals to indicate [ ].

  [ ]

- Identify transition and main-group elements / [ ] ions.
  - Main-group metals/polyatomic ions have fixed charges.
- Use charge balance to determine charge on transition metal.
  - Use [ ] ions to determine charge [ ].
- Write name as usual, using roman numerals to indicate charge.
  - Write roman numerals in parentheses.

Use roman numerals only for transition metals that commonly have multiple charges.

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Summary | Nomenclature of Ionic Compounds

Lesson Question

What is the method of naming ionic compounds?

Answer

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Naming Simple Ionic Compounds

- The net charge on an ionic compound is _____.
- The cation name is given first, followed by the anion name.
- The cation name appears unmodified.
- For binary compounds, the name of the anion is determined by replacing the end of the element name with *-ide*.
- All polyatomic ions are named “as is,” regardless of whether they are a cation or an anion.
- The name of a _____ can be used to determine the formula.

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Naming More Complex Ionic Compounds

- In all ionic compound names, the cation name is given first, followed by the _____ name.
- Polyatomic ions are treated as a single unit when naming and writing formulas for ionic compounds.
- Polyatomic ions can be anions or cations.
- Most transition _____ can have more than one charge.
- Roman numerals are used to indicate charges on transition metals.

Use this space to write any questions or thoughts about this lesson.

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