

CHAPTER 6: Ionic Bonds and Ionic Compounds

Part 1: Ionic Bond

- Ions are formed when atoms gain or lose valence electrons to achieve a stable octet electron configuration.
- A **positively** charged ion is called a **cation**
- Metals are reactive because they lose valence electrons easily.
- An anion is a negatively charged ion.
- A chemical bond is the force that holds two atoms together.
- The electrostatic force that holds oppositely charged particles together in an ionic compound is called an **ionic bond**.
- A **crystal lattice** is the three-dimensional geometric arrangement of particles, and is responsible for the structure of many minerals
- An ion in aqueous solution that conducts electricity is an electrolyte.
- Compounds that contain ionic bonds are called ionic compounds.
- Binary ionic compounds contain only two different elements—a metallic cation and a nonmetallic anion.
- Oxidation number, or oxidation state, is the charge of a monatomic ion.
- The energy required to separate 1 mol of ions in an ionic compound is referred to as the lattice energy.
- Lattice energy is directly related to the size of the ions that are bonded.
- Smaller ions form compounds with more closely spaced ionic charges and require more energy to separate. (INVERSE)
- lattice energy is also affected by the charge of the ion. (DIRECT)

1 Elements with a full octet have which configuration?

- CH A Ionic configuration
6 B Halogen configuration
C Noble gas configuration
D Transition metal configuration
Noble gas configuration = Elements with a full octet →C

2 When aluminum oxide is formed:

- CH A Oxygen loses $3e^-$ & aluminium gains $2e^-$
6 B Aluminium loses $3e^-$ & oxygen gains $2e^-$
C Aluminium loses $2e^-$ & oxygen gains $3e^-$
D aluminium loses $2e^-$ & oxygen gains $2e^-$
Aluminium (Al) will lose $3e^-$ because it's arranged in group 13 or 3 A, Oxygen will gain $2e^-$ because it's arranged in group 16 or 6 A →B

3 What is the electrostatic charge holding two ions together?

- CH A Covalent bond
6 B Pseudo-noble gas bond
C Crystal lattice bond
D Ionic bond
The electrostatic force that holds oppositely charged particles together in an ionic compound is called an ionic bond. →D

4 Cations form when atoms _____ electrons.

- CH A Gain B Lose C Charge D Delocalize
6 Cations form when atoms lose electrons →B

5 How many electrons are in a full octet?

- CH A 10 B 8 C 6 D 4
6 Full octet = $8e^-$ →B

6 Which atom is most likely to form a 3^+ ion? (Atomic number for Li=3, N=7, O=8, Al=13)

- CH A Li B N C O D Al
6 Al, because it has 3 valence electrons →D

7 Which atom is most likely to form a 1^+ ion? (Atomic number for Li=3, N=7, O=8, Al=13)

- CH A Li B N C O D Al
6 Li, because it has 1 valence electrons →A

8 Which combination of atoms is most likely to produce a compound with ionic bonds?

- (Atomic number for H=1, Li=3, N=7, O=8, Al=13)
CH A Li and Al B N and O C H and O D Al and O
6 Al classified as metallic element; O classified as non-metallic element, ionic bonds formed between metallic and non-metallic elements →D

9 Ionic bond formation depends on the arrangement of _____

- CH A Molecule B Atom
6 C Lattice D Kernel
Lattice of the crystalline compound is the arrangement of positive and the negative ions inside a substance. It is dependent on the ease of formation of ionic bonds. →C

10 As the distance between ions in an ionic bond is shortened, ...

- CH A the energy to break the bond decreases.
6 B the electrostatic attraction decreases.
C the electrostatic attraction increases.
D the ionic bond changes to a metallic bond.
As the distance between ions in an ionic bond is Shortened, the electrostatic attraction increases. →C

11 What is the repeating pattern of atoms in an ionic solid called?

- CH A Crystal lattice B Ionic lattice
6 C Energy lattice D ionic bonding
A crystal lattice is the three-dimensional geometric arrangement of particles, and is responsible for the structure of many minerals →A

12 Which compound has the higher lattice energy: (Atomic number for Li=3, F=9, Na=11, Mg=12, Al=13)

- CH A LiF B NaF
6 C MgF_2 D AlF_3
Lattice energy is also affected by the charge of the ion. (DIRECT) →D

1 Which compound has the higher lattice energy: (Atomic number for, F=9, Na=11, Cl=17, Br=35, I= 53)

- Do It? A NaF B NaBr C NaCl D NaI

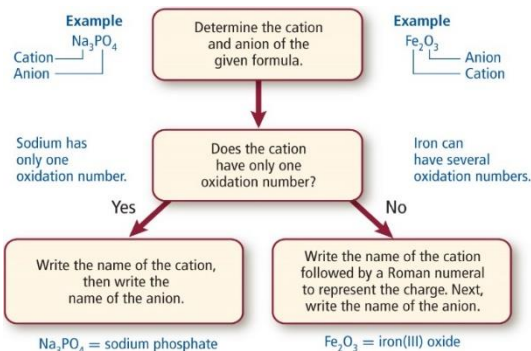
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Part 2: Names and Formulas for Ionic Compounds

- A **formula unit** represents the simplest ratio of the ions involved.

Steps of naming ionic compounds

- Chemical nomenclature is a systematic way of naming compounds.
- Name the cation followed by the anion.
- For monatomic cations use the element name.
- For monatomic anions, use the root element name and the suffix *-ide*.
- To distinguish between different oxidation states of the same element, the oxidation state is written in parentheses after the name of the cation.
- When the compound contains a polyatomic ion, name the cation followed by the name of the polyatomic ion.



Symbol	Name
H ⁺	Hydrogen ion
Li ⁺	Lithium ion
Na ⁺	Sodium ion
K ⁺	Potassium ion
Rb ⁺	Rubidium ion
Cs ⁺	Cesium ion
Be ²⁺	Beryllium ion
Mg ²⁺	Magnesium ion
Ca ²⁺	Calcium ion
Ba ²⁺	Barium ion
Al ³⁺	Aluminium ion

Symbol	Name
F ⁻	Fluoride
Cl ⁻	Chloride
Br ⁻	Bromide
I ⁻	Iodide
O ²⁻	Oxide
S ²⁻	Sulfide
N ³⁻	Nitride
P ³⁻	Phosphide

Common Polyatomic Ions			
Ion	Name	Ion	Name
NH ₄ ⁺	Ammonium	CO ₃ ²⁻	Carbonate
NO ₂ ⁻	Nitrite	HCO ₃ ⁻	Bicarbonate
NO ₃ ⁻	Nitrate	ClO ⁻	Hypochlorite
SO ₃ ²⁻	Sulfite	ClO ₂ ⁻	Chlorite
SO ₄ ²⁻	Sulfate	ClO ₃ ⁻	Chlorate
HSO ₄ ⁻	Bisulfate	ClO ₄ ⁻	Perchlorate
OH ⁻	Hydroxide	C ₂ H ₃ O ₂ ⁻	Acetate
CN ⁻	Cyanide	MnO ₄ ⁻	Permanganate
PO ₄ ³⁻	Phosphate	Cr ₂ O ₇ ²⁻	Dichromate
HPO ₄ ²⁻	Hydrogen phosphate	CrO ₄ ²⁻	Chromate
H ₂ PO ₄ ⁻	Dihydrogen phosphate	O ₂ ²⁻	Peroxide

Symbol	Systematic name (Stock system)	Classical name	Symbol	Systematic name (Stock system)	Classical name
Cu ¹⁺	Copper (I)	Cuprous	Hg ₂ ²⁺	Mercury (I)	Mercurous
Cu ²⁺	Copper (II)	Cupric	Hg ²⁺	Mercury (II)	Mercuric
Fe ²⁺	Iron (II)	Ferrous	Pb ²⁺	Lead (II)	Plumbous
Fe ³⁺	Iron (III)	Ferric	Pb ⁴⁺	Lead (IV)	plumbic
Sn ²⁺	Tin (II)	Stannous	Co ²⁺	Cobalt (II)	Cobaltous
Sn ⁴⁺	Tin (IV)	Stannic	Co ⁴⁺	Cobalt (II)	Cobaltic
Cr ²⁺	Chromium (II)	Chromous	Au ⁺	Gold (I)	Aurous
Cr ³⁺	Chromium (III)	Chromic	Au ³⁺	Gold (III)	Auric
Mn ²⁺	Manganese (II)	Manganous	Ni ²⁺	Nickel (II)	Nickelous
Mn ³⁺	Manganese (III)	Manganic	Ni ³⁺	Nickel (III)	Nickelic

13 The name of NaF is

- CH A Nitrogen fluorine B Sodium fluoride
 6 C Nitrogen fluoride D Sodium fluoride
- By using ions tables, we will find that the first part Na⁺ name is Sodium, F⁻ the second part name is fluoride
 So the name is Sodium fluoride →B

17 The formula of Lithium carbonate is

- CH A Li₃CO₃ B Li₂CO₃
 6 C Li(CO₃)₂ D Li₂(CO₃)₃
- Lithium ion is Li⁺, carbonate is CO₃⁻, so the formula is Li₂CO₃ →B

14 The name of CaCl₂ is

- CH A Carbon chloride B Calcium bromide
 6 C Calcium dichloride D Calcium chloride
- By using ions tables, we will find that the first part Ca²⁺ name is Calcium, Cl⁻ the second part name is chloride
 So the name is Calcium chloride →D

18 The formula of Iron (II) nitrate is

- CH A Fe₂NO₃ B Fe(NO₃)₂
 6 C FeNO₃ D Fe₂(NO₃)₃
- Iron (II) is Fe²⁺, Nitrate is NO₃⁻, so the formula is Fe(NO₃)₂ →B

15 The name of MgSO₄ is

- CH A Magnesium sulfide B Magnesium sulfite
 6 C Magnesium sulfate D Magnesium disulfide
- By using ions tables, we will find that the first part Mg²⁺ name is Magnesium, SO₄²⁻ the second part name is sulfate
 So the name is Magnesium sulfate. →C

2 The name of Al₂(SO₄)₃ is

- Do A Dialuminium sulfate B Aluminium sulfate
 It? C Aluminium sulfite D Aluminium disulfate

3 The formula of Chromium (III) chloride is

- Do A CrCl₂ B Cr₃Cl₂
 it? C CrCl D CrCl₃

16 The name of Ca₃(PO₄)₂ is

- CH A Calcium diphosphate B Calcium phosphite
 6 C Dicalcium diphosphate D Calcium phosphate
- By using ions tables, we will find that the first part Ca²⁺ name is Calcium, PO₄³⁻ the second part name is phosphate
 So the name is Calcium phosphate. →D

Chapter 6: Do It Answer key

1	2	3
A	B	D