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 6
A Ionic configuration
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 6
A Oxygen loses $3e^-$ & aluminium gains 2 e^-
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 3 e^- because it's arranged in group 13 or 3 A, Oxygen will gain 2 e^- because it's arranged in group 16 or 6 A →B

3 **What is the electrostatic charge holding two ions together?**
CH 6
A Covalent bond
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 6
A Gain **B** Lose **C** Charge **D** Delocalize
Cations form when atoms lose electrons →B

5 **How many electrons are in a full octet?**
CH 6
A 10 **B** 8 **C** 6 **D** 4
Full octet = 8 e^- →B

6 **Which atom is most likely to form a 3^+ ion? (Atomic number for Li=3, N=7, O=8 , Al=13)**
CH 6
A Li **B** N **C** O **D** Al
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 6
A Li **B** N **C** O **D** Al
Li, because it has 1 valence electrons →D

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 6
A Li and Al **B** N and O **C** H and O **D** Al and O
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 6
A Molecule **B** Atom
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 6
A the energy to break the bond decreases.
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 6
A Crystal lattice **B** Ionic lattice
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 6
A LiF **B** NaF
C MgF_2 **D** AlF_3
Lattice energy is also affected by the charge of the ion. (DIRECT) →D

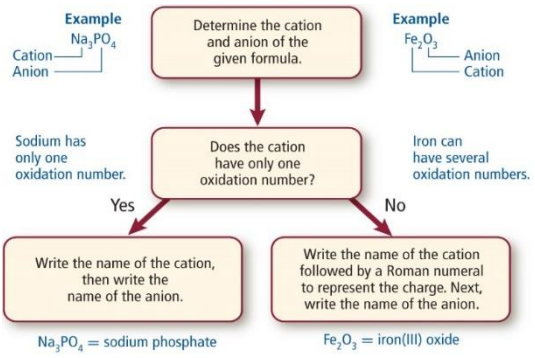
1 **Which compound has the higher lattice energy: (Atomic number for, F=9, Na=11, Cl=17, Br=35, I= 53)**
Do It?
A NaF **B** NaBr **C** NaCl **D** NaI

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	$C_2H_3O_2^-$	Acetate
CN^-	Cyanide	MnO_4^-	Permanganate
PO_4^{3-}	Phosphate	$Cr_2O_7^{2-}$	Dichromate
HPO_4^{2-}	Hydrogen phosphate	CrO_4^{2-}	Chromate
$H_2PO_4^-$	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 6 **A** Nitrogen fluorine **B** Sodium fluoride **C** Nitrogen fluoride **D** Sodium fluorine

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

14 **The name of $CaCl_2$ is**

CH 6 **A** Carbon chloride **B** Calcium bromide **C** Calcium dichloride **D** Calcium chloride

By using ions tables, we will find that the first part Ca^{+2} name is Calcium, Cl^- the second part name is chloride
So the name is Calcium chloride →D

15 **The name of $MgSO_4$ is**

CH 6 **A** Magnesium sulfide **B** Magnesium sulfite **C** Magnesium sulfate **D** Magnesium disulfide

By using ions tables, we will find that the first part Mg^{+2} name is Magnesium, SO_4^{2-} the second part name is sulfate So the name is Magnesium sulfate. →C

16 **The name of $Ca_3(PO_4)_2$ is**

CH 6 **A** Calcium diphosphate **B** Calcium phosphite **C** Dicalcium diphosphate **D** Calcium phosphate

By using ions tables, we will find that the first part Ca^{+2} name is Calcium, PO_4^{3-} the second part name is phosphate So the name is Calcium phosphate. →D

17 **The formula of Lithium carbonate is**

CH 6 **A** Li_3CO_3 **B** Li_2CO_3 **C** $Li(CO_3)_2$ **D** $Li_2(CO_3)_3$

Lithium ion is Li^+, carbonate is CO_3^{--}, so the formula is Li_2CO_3 →B

18 **The formula of Iron (II) nitrate is**

CH 6 **A** Fe_2NO_3 **B** $Fe(NO_3)_2$ **C** $FeNO_3$ **D** $Fe_2(NO_3)_3$

Iron (II) is Fe^{2+}, Nitrate is NO_3^{--}, so the formula is $Fe(NO_3)_2$ →B

2 **The name of $Al_2(SO_4)_3$ is**

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

3 **The formula of Chromium (III) chloride is**

Do it? **A** $CrCl_2$ **B** Cr_3Cl_2 **C** $CrCl$ **D** $CrCl_3$

Chapter 6: Do It Answer key

1	2	3
A	B	D