Chapter 7 : Ionic Compounds and Metals

Section 1 & 2 Notes

Section 7-1

- A **chemical bond** is the force that holds two atoms together.
- Chemical bonds form by the attraction between the positive nucleus of one atom and the negative electrons of another atom.

Section 7-1

- Atom's try to form the octet—the stable arrangement of eight valence electrons in the outer energy level—by gaining or losing valence electrons.

Table 7.1 Electron-Dot Structures

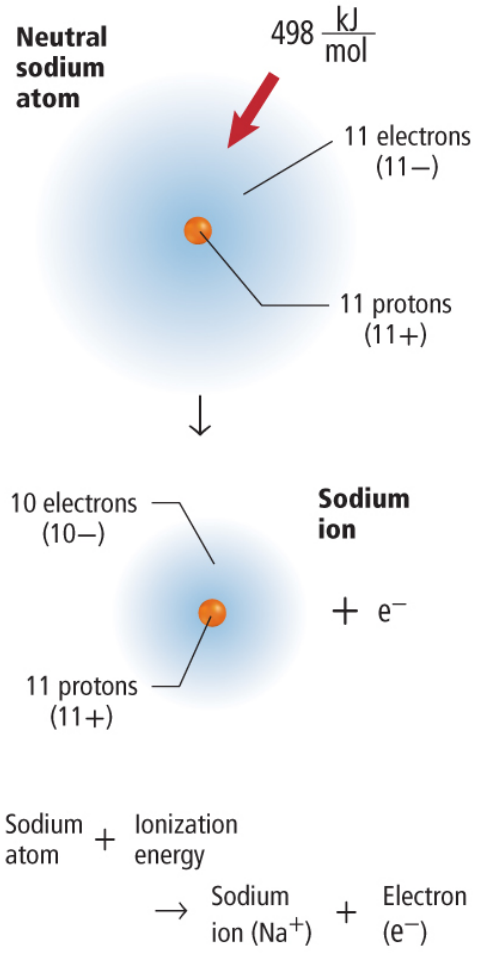
Group	1	2	13	14	15	16	17	18
Diagram	Li·	·Be·	·B·	·C·	·N·	·O:	:F:	:Ne:

Concepts In Motion
Click here to view an animated version of this graphic.

Positive Ion Formation

Section 7-1

- A positively charged ion is called a **cation**.
- This figure illustrates how sodium loses one valence electron to become a sodium cation.



Section 7-1

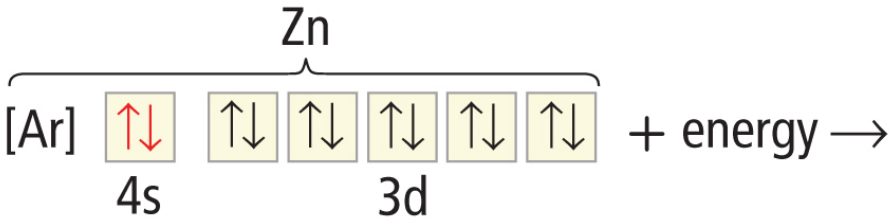
- Metals are reactive because they lose valence electrons easily.

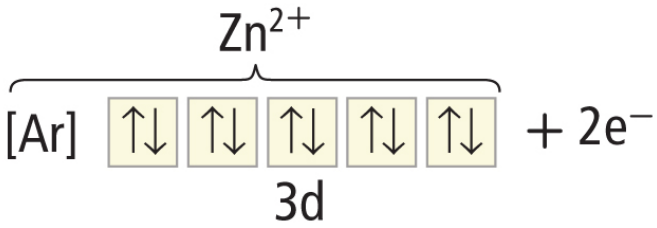
Table 7.2 Group 1, 2, and 13 Ions

Group	Configuration	Charge of Ion Formed
1	[noble gas] ns^1	1+ when the s^1 electron is lost
2	[noble gas] ns^2	2+ when the s^2 electrons are lost
13	[noble gas] ns^2np^1	3+ when the s^2p^1 electrons are lost

Section 7-1

- Transition metals commonly form 2+ or 3+ ions, but can form greater than 3+ ions.
- Other relatively stable electron arrangements are referred to as pseudo-noble gas configurations.

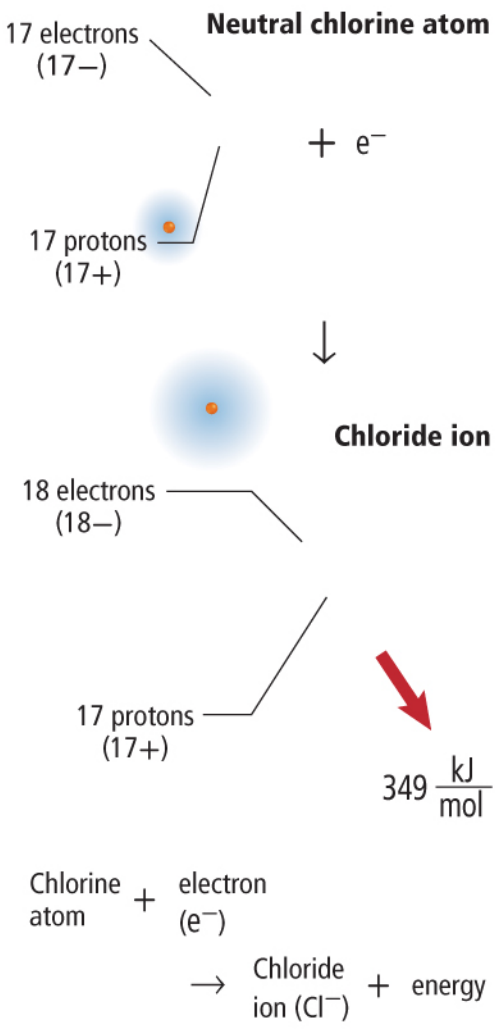




Negative Ion Formation

Section 7-1

- An **anion** is a negatively charged ion.
- The figure shown here illustrates chlorine gaining an electron to become a chlorine ion.



Section 7-1

- Nonmetal ions gain the number of electrons required to fill an octet.
- Some nonmetals can gain or lose electrons to complete an octet.

Table 7.3 Group 15–17 Ions

Group	Configuration	Charge of Ion Formed
15	[noble gas] ns^2np^3	3– when three electrons are gained
16	[noble gas] ns^2np^4	2– when two electrons are gained
17	[noble gas] ns^2np^5	1– when one electron is gained

Section 7-2

- The electrostatic force that holds oppositely charged particles together in an ionic compound is called an **ionic bond**.
- Compounds that contain ionic bonds are called **ionic compounds**.
- Binary ionic compounds contain only two different elements—a metallic cation and a nonmetallic anion.

Formation of an Ionic Bond (cont.)

Section 7-2

Table 7.4 Formation of Sodium Chloride

Chemical Equation

$Na + Cl \rightarrow Na^+ + Cl^- + \text{energy}$

Electron Configurations

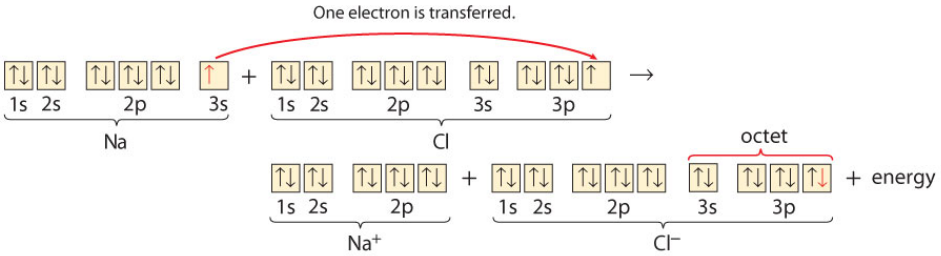
One electron is transferred.

$[Ne]3s^1 + [Ne]3s^23p^5 \rightarrow [Ne] + [Ar] + \text{energy}$

Na Cl Na^+ Cl^-

Orbital Notation

One electron is transferred.

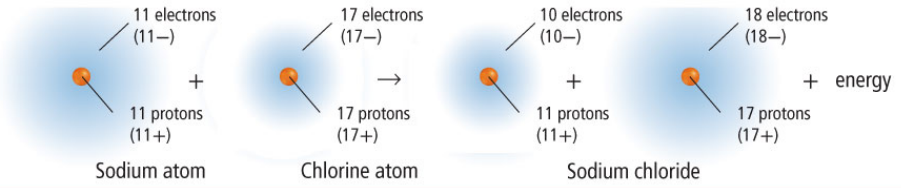


Electron-Dot Structures

One electron is transferred.

$Na\cdot + \cdot\ddot{Cl}: \rightarrow [Na]^+ + [:\ddot{Cl}:]^- + \text{energy}$

Atomic Models



Concepts In Motion

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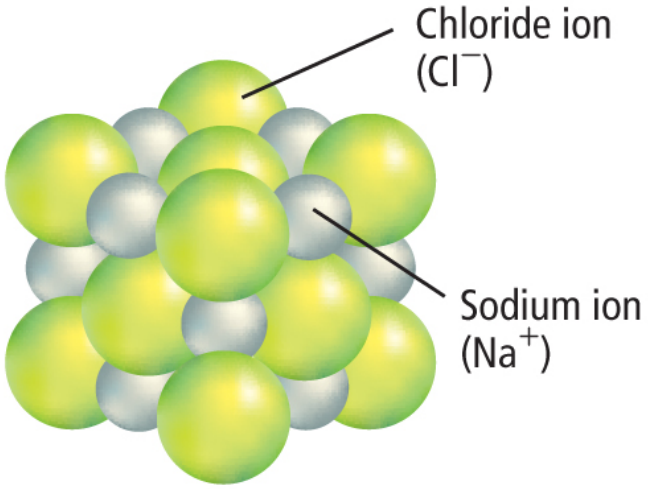
Section 7-2

- Positive and negative ions exist in a ratio determined by the number of electrons transferred from the metal atom to the non-metal atom.

- The repeating pattern of particle packing in an ionic compound is called an ionic crystal.



Sodium chloride crystal

Section 7-2

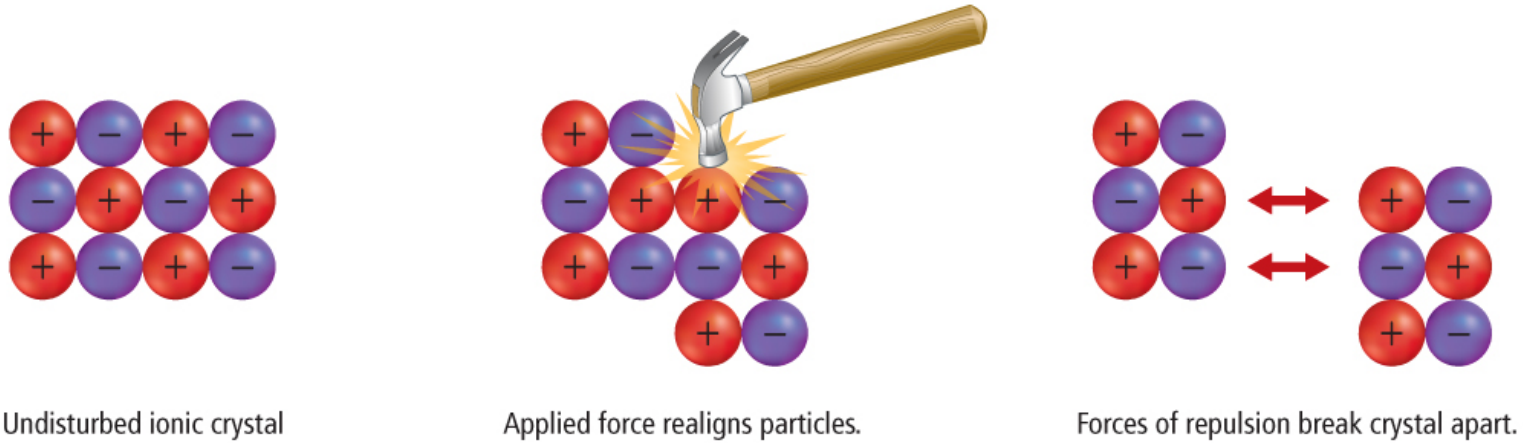
- The strong attractions among the positive and negative ions result in the formation of the crystal lattice.
- A **crystal lattice** is the three-dimensional geometric arrangement of particles, and is responsible for the structure of many minerals.

Section 7-2

- In a solid, ions are locked into position and electrons cannot flow freely—solid ions are poor conductors of electricity.
- Liquid ions or ions in aqueous solution have electrons that are free to move, so they conduct electricity easily.
- An ion in aqueous solution that conducts electricity is an **electrolyte**.

Section 7-2

- This figure demonstrates how and why crystals break when an external force is applied.



Undisturbed ionic crystal

Applied force realigns particles.

Forces of repulsion break crystal apart.

Section 7-2

- Reactions that absorb energy are endothermic.

- Reactions that release energy are exothermic.

Section 7-2

- 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.

Section 7-2

- Smaller ions form compounds with more closely spaced ionic charges, and require more energy to separate.
- Electrostatic force of attraction is inversely related to the distance between the opposite charges.
- The smaller the ion, the greater the attraction.

Section 7-2

- The value of lattice energy is also affected by the charge of the ion.

Table 7.6 Lattice Energies of Some Ionic Compounds

Compound	Lattice Energy (kJ/mol)	Compound	Lattice Energy (kJ/mol)
KI	632	KF	808
KBr	671	AgCl	910
RbF	774	NaF	910
NaI	682	LiF	1030
NaBr	732	$SrCl_2$	2142
NaCl	769	MgO	3795