CHAPTER 7
Chemical Bonding

1. Ionic Bonding
2. Covalent Bonding
3. Lewis Dot Formulas of Atoms
4. Lewis Formulas for Molecules & Polyatomic Ions
5. The Octet Rule
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Introduction

- *Ionic bonding* results from electrostatic attractions among ions, which are formed by the transfer of one or more electrons from one atom to another.
- *Covalent bonding* results from sharing one or more electron pairs between two atoms.

Ionic compounds	Covalent compounds
usually solids with **high** melting points, typically > 400 °C	gases, liquids, or solids with **low** melting points, typically < 300 °C
generally **soluble** in **polar solvents**	generally **insoluble** in **polar solvents**
generally **insoluble** in **nonpolar solvents**	generally **soluble** in **nonpolar solvents**
generally **conduct** electricity in molten solids and liquids	generally **do not conduct** electricity in molten solids and liquids
generally **conduct** electricity in aqueous solutions	are **poor conductors** of electricity in aqueous solutions
are formed between elements with large differences in electronegativity	are formed between elements with similar electronegativities

Formation of Ionic Compounds

	1s	2s	2p	
Li	↑↓	↑		
F	↑↓	↑↓	↑↓ ↑↓ ↑	

These atoms form ions with these configurations.

Li^+	↑↓			same configuration as [He]
F^-	↑↓	↑↓	↑↓ ↑↓ ↑↓	same configuration as [Ne]

Formation of Ionic Compounds

- The Li^+ ion contains two electrons, same as the helium atom.
  - Li^+ ions are isoelectronic with helium.
- The F^- ion contains ten electrons, same as the neon atom.
  - F^- ions are isoelectronic with neon.
- *Isoelectronic* species contain the same number of electrons.

Formation of Ionic Compounds

	4s	4p	
K	[Ar] ↑		
Br	[Ar] ↑↓	↑↓ ↑↓ ↑	and the d electrons

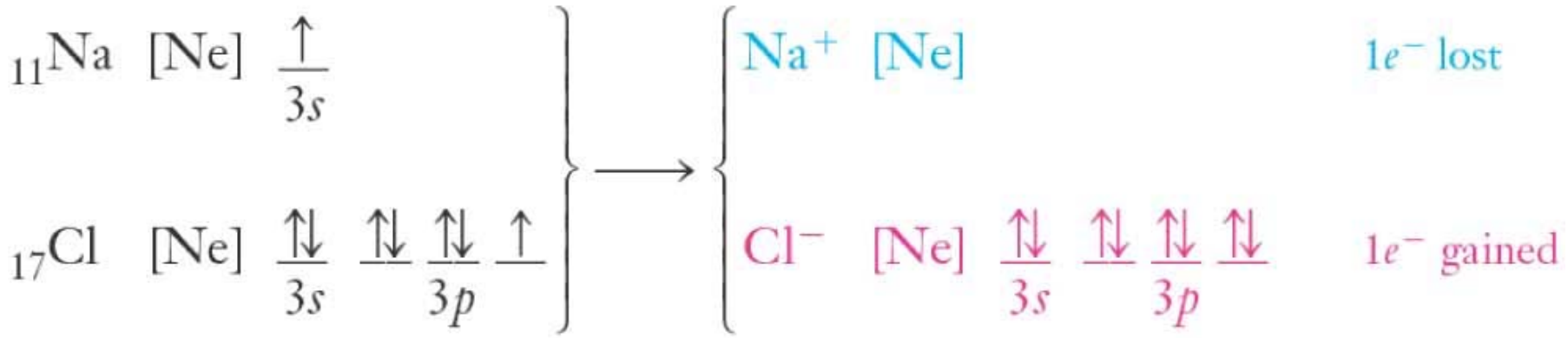
The atoms form ions with these electronic structures.

	4s	4p	
K^+			same configuration as [Ar]
Br^-	↑↓	↑↓ ↑↓ ↑↓	same configuration as [Kr]

Formation of Ionic Compounds

- Cations become ***isoelectronic*** with the **preceding** noble gas.
- Anions become ***isoelectronic*** with the **following** noble gas.

Formation of Ionic Compounds



Formation of Ionic Compounds

- Notable exceptions are $BeCl_2$, $BeBr_2$, and BeI_2 which are covalent compounds.

- One example is the reaction of Be and F_2.

$$Be_{(solid)} + F_{2(gas)} \rightarrow BeF_{2(gas)}$$

Formation of Ionic Compounds

$$Be_{(solid)} + F_{2(gas)} \rightarrow BeF_{2(gas)}$$

	2s	2p		2s	2p
Be [He]	↑↓		→ Be^{2+}		
F [He]	↑↓	↑↓ ↑↓ ↑	→ F^-	↑↓	↑↓ ↑↓ ↑↓

Formation of Ionic Compounds

- Draw the electronic configurations for Li, O, and their appropriate ions.
  - **$Li_{(solid)} + O_{2(gas)} \rightarrow Li_2O_{(solid)}$**

	2s	2p		2s	2p
Li [He]	↑		→ Li^{1+}		
O [He]	↑↓	↑↓ ↑ ↑	→ O^{2-}	↑↓	↑↓ ↑↓ ↑↓

Formation of Ionic Compounds

- Draw the electronic representation of Ca, N, and their ions.

$$3\,Ca_{(s)} + N_{2(g)} \rightarrow Ca_3N_{2(s)}$$

	4s	4p		4s	4p
Ca [Ar]	↑↓		→ Ca^{2+}		

	2s	2p		2s	2p
N [He]	↑↓	↑ ↑ ↑	→ N^{3-}	↑↓	↑↓ ↑↓ ↑↓

Formation of Ionic Compounds

- Ionic compounds form extended three dimensional arrays of oppositely charged ions.
- Ionic compounds have high melting points because the coulomb force, which holds ionic compounds together, is strong.

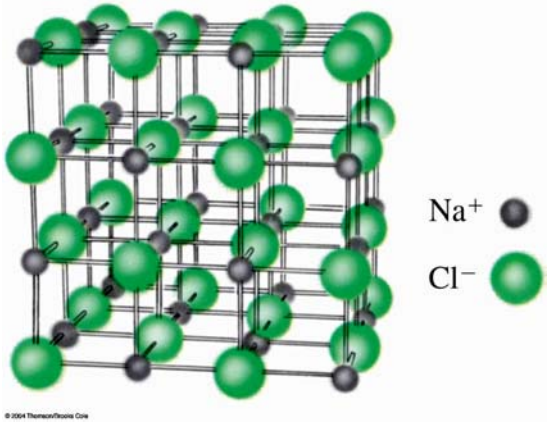
$$F \propto \frac{(q^+)(q^-)}{d^2}$$

where

F = force of attraction between ions

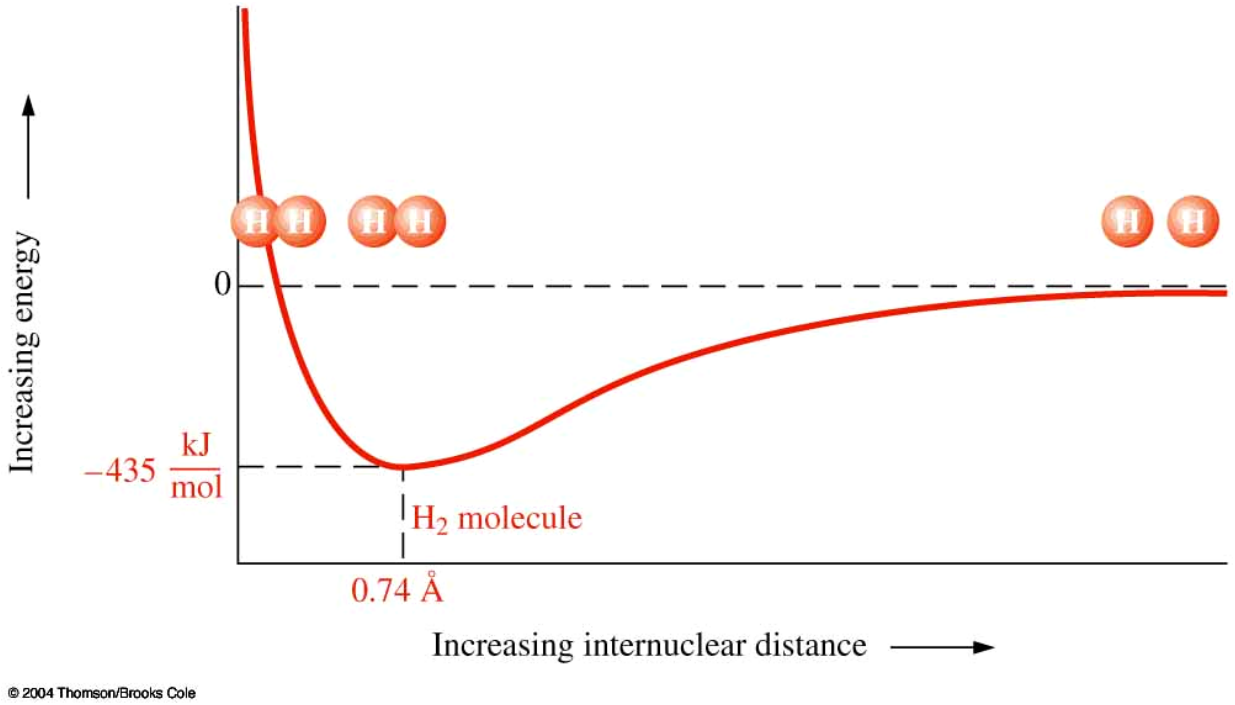
q = magnitude of charge on ions

d = distance between center of ions



Formation of Covalent Bonds

- This figure shows the potential energy of an H_2 molecule as a function of the distance between the two H atoms.



Formation of Covalent Bonds

- Representation of the formation of an H_2 molecule from H atoms.