Ionic Compounds & Metals

Ion Formation

Valence Electrons & Chemical Bonds

- **Main Idea**: _____ are formed when atoms gain or lose _____ electrons to achieve a _____ _____ electron configuration.

  - Atoms gain or lose electrons to form _____

Table 7.1 Electron-Dot Structures

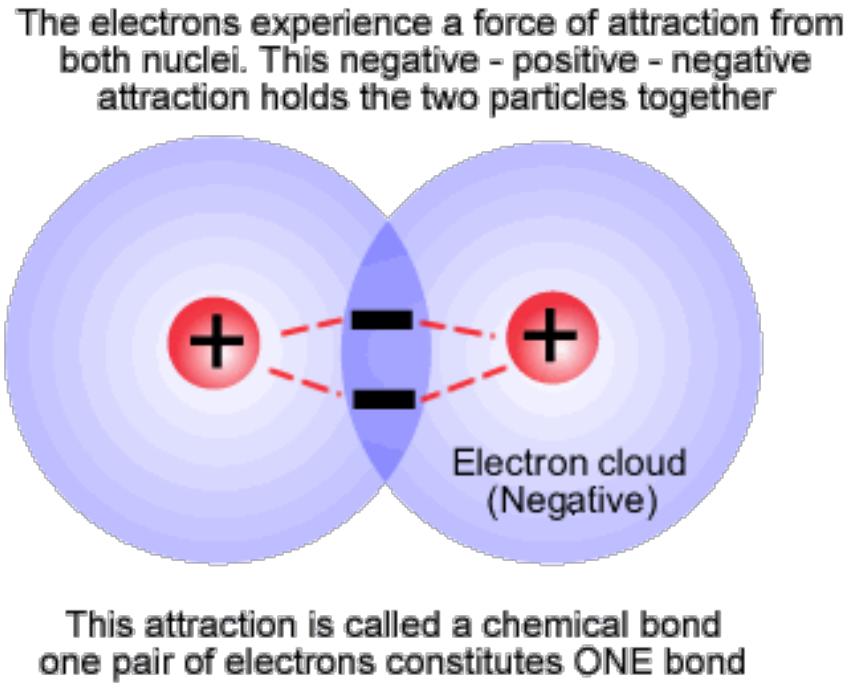
Group	1	2	13	14	15	16	17	18
Diagram	Li·	·Be·	·B·	·C·	·N·	·O:	:F:	:Ne:

Valence Electrons & Chemical Bonds

- How do so many compounds form from relatively few elements known to exist?
  - Due to the electron _____ of atoms and the nature of _____ between atoms.
    - **Review**: Similar _____ of elements within a _____ on the Periodic Table depends on the _____ of valence electrons.
    - Valence electrons also involved in the formation of _____ _____ between atoms.

Valence Electrons & Chemical Bonds

- Chemical bond is the _____ that holds ____ atoms together.
  - Formed by the _____ between the positive _____ of one atom and the negative _____ of another atom.
  - Formed by the attraction between _____ and _____ ions.
  - Ionization energy refers to how _____ an atom _____ an electron



Valence Electrons

- _____ ___ structures keep _____ of valence electrons.
  - Consists of element's _____.
  - Each _____ refers to a _____ _____.
  - N = column 5 =

Electron Dot Structures of Some Group A Elements

Period	Group 1A	2A	3A	4A	5A	6A	7A	8A
1	H·							He:
2	Li·	·Be·	·B·	·C·	·N·	:O·	:F·	:Ne:
3	Na·	·Mg·	·Al·	·Si·	·P·	:S·	:Cl·	:Ar:
4	K·	·Ca·	·Ga·	·Ge·	·As·	:Se·	:Br·	:Kr:

Electron Arrangement: Electron Dot Structures

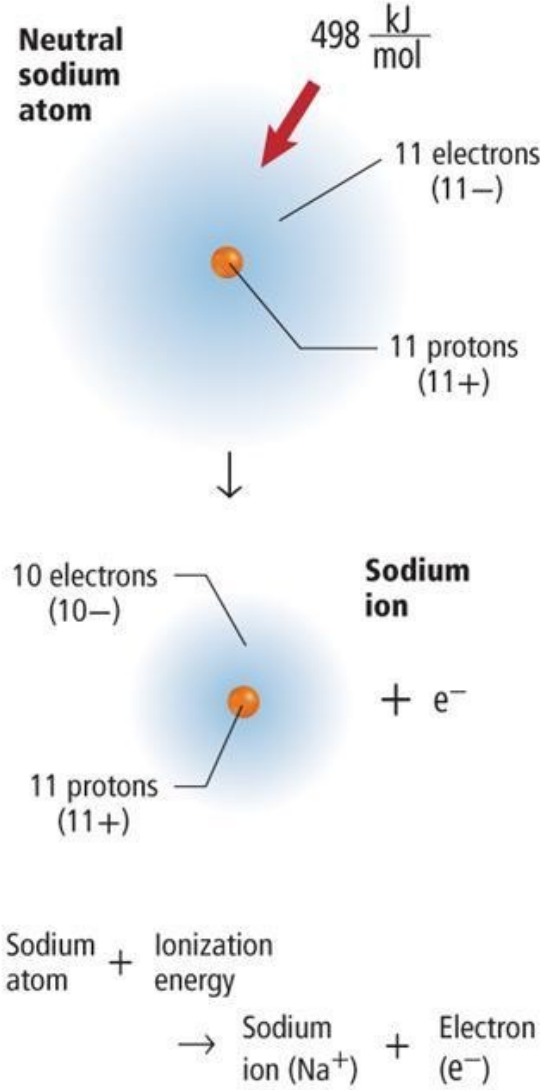
- Li (column __):
- B (column __):
- O (column __):
- Cl (column __):
- Mg (column __):

Valence Electrons

- Differences in _____ between elements is _____ related to the _____ electrons.
  - Involves _____.
    - _____ arrangement of _____ valence electrons in the _____ energy level.
  - Noble gases = _____ outer shell.
    - Elements _____ to acquire the electron _____ of a noble gas & become _____ _____.

Positive Ion Formation

- _____ ions form when an atom _____ valence electrons to achieve a noble gas configuration.
  - **ie~**
  - Positive ion = _____
  - _____ atoms are reactive b/c they lose valence electrons _____ & form _____.



Positive Ion Formation

- **Formation of Cations** Example: Sodium

	Atom	Ion
Electron configuration		
Orbital diagram		
Electron Dot diagram		

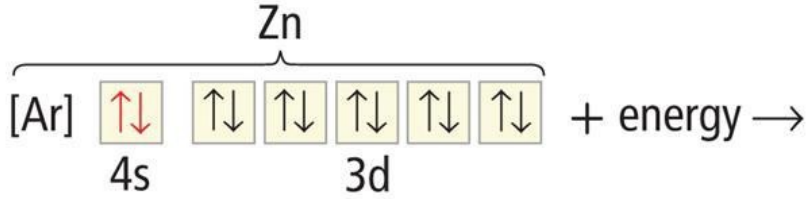
Positive Ion Formation

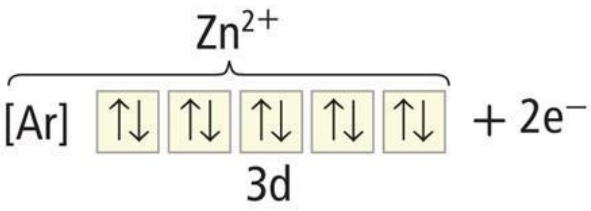
- **Formation of Cations** Example: Magnesium

	Atom	Ion
Electron configuration		
Orbital diagram		
Electron Dot diagram		

Transition Metal Ions

- Can form _____ ions.
- **Rule of thumb:** Form ions with a ____ or ___ charge.
  - Can lose two or three valence electrons depending on the number of ___ _____.
    - Difficult to predict.





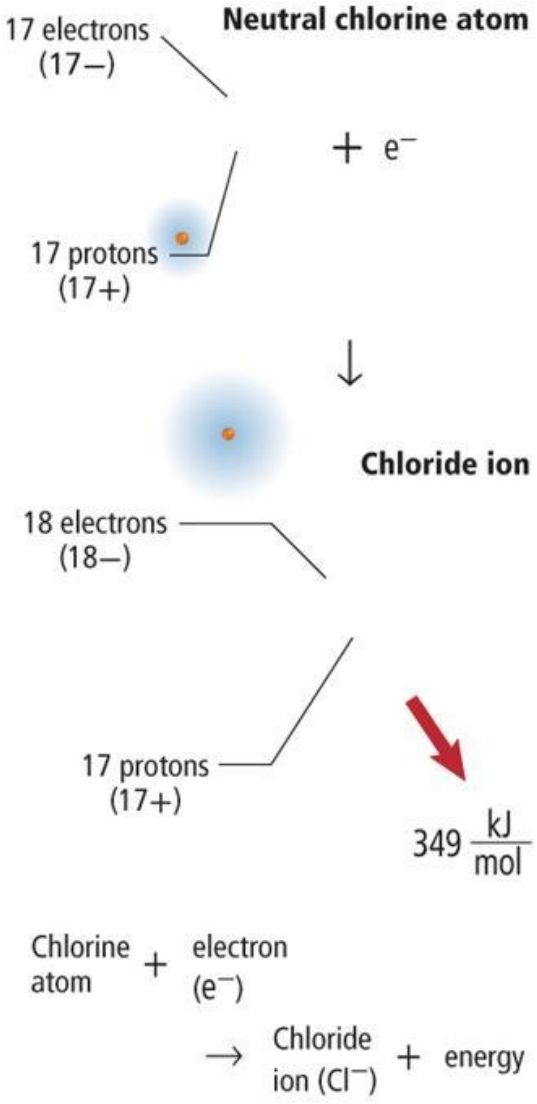
Positive Ion Formation

- **Transition Metal Cations-** Example: Iron

	Atom	Ion
Electron configuration		
Orbital diagram		
Electron Dot diagram		

Negative Ion Formation

- _____ _____ electrons to attain a _____ outer electron configuration (octet).
  - **ie~**.
    - Referred to as "_____ ion"
  - Negatively charged ions are _____.
    - _____ form anions
    - The ending _____ is added to the _____ name of an element to show that it is an anion.
      - What is the name of a nitrogen anion?

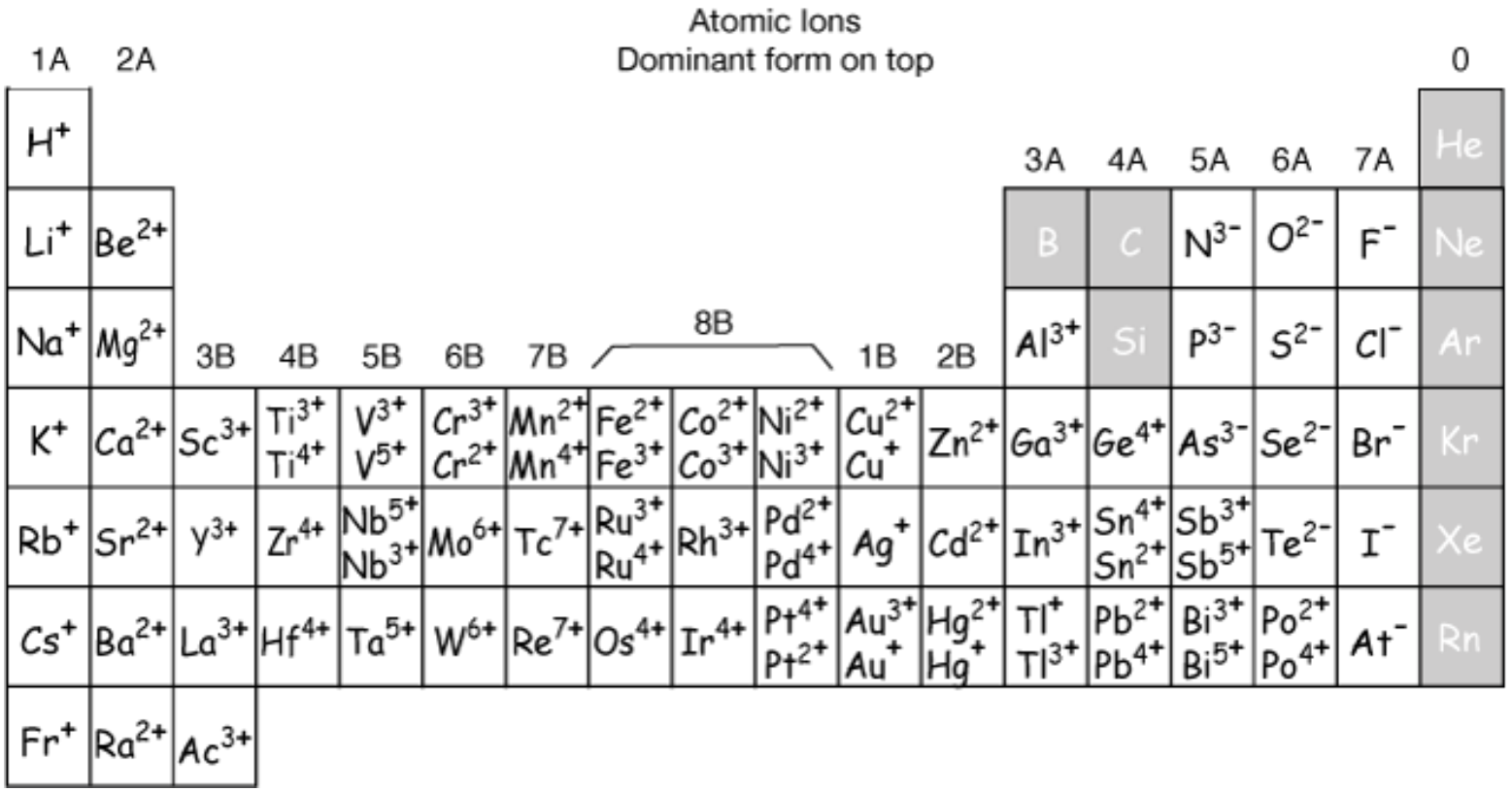


Positive Ion Formation

- Transition Metal Anions- Example: Chlorine

	Atom	Ion
Electron configuration		
Orbital diagram		
Electron Dot diagram		

Ions: Elements that Lose or Gain Electrons



Ionic Compounds & Metals

Ionic Bonds & Ionic Compounds

Formation of an Ionic Bond

- **Main Idea**: _____ charged ions _____ each other, forming _____ _____ ionic compounds.

- The _____ _____ that holds oppositely charged particles together in an ionic compound = _____ _____.

Formation of an Ionic Bond

- Compounds containing _____ _____ = _____ compounds.
  - Ionic bonds between _____ and _____ are named _____.
  - All other ionic bonds commonly referred to as _____.
  - _____ ionic compounds contain only ____ elements.
    - _____ cation & _____ anion
      - **ie~**

Compound Formation & Charge

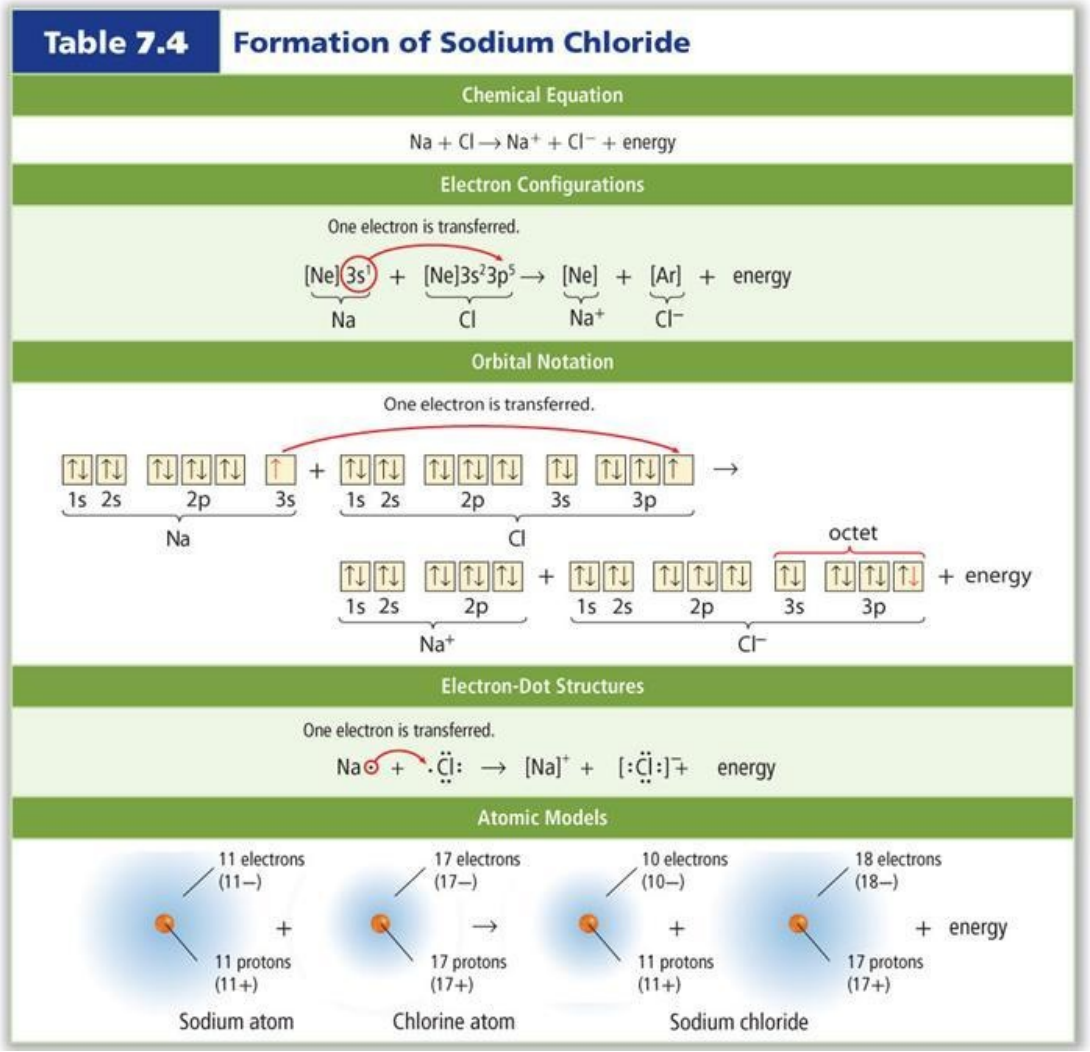
- What role does ionic charge play in forming ionic compounds?
  - Number of electrons _____ and _____ must be _____.
    - Overall _____ must equal _____.
    - ie~

Compound Formation & Charge

- Number of electrons gained and lost must be equal.
    - sodium & chlorine:
    - sodium & oxygen:
    - magnesium & chlorine:
    - magnesium & nitrogen:
    - calcium & oxygen:

Compound Formation & Charge

- Table 7.4 shows several ways the formation of an ionic compound can be represented.

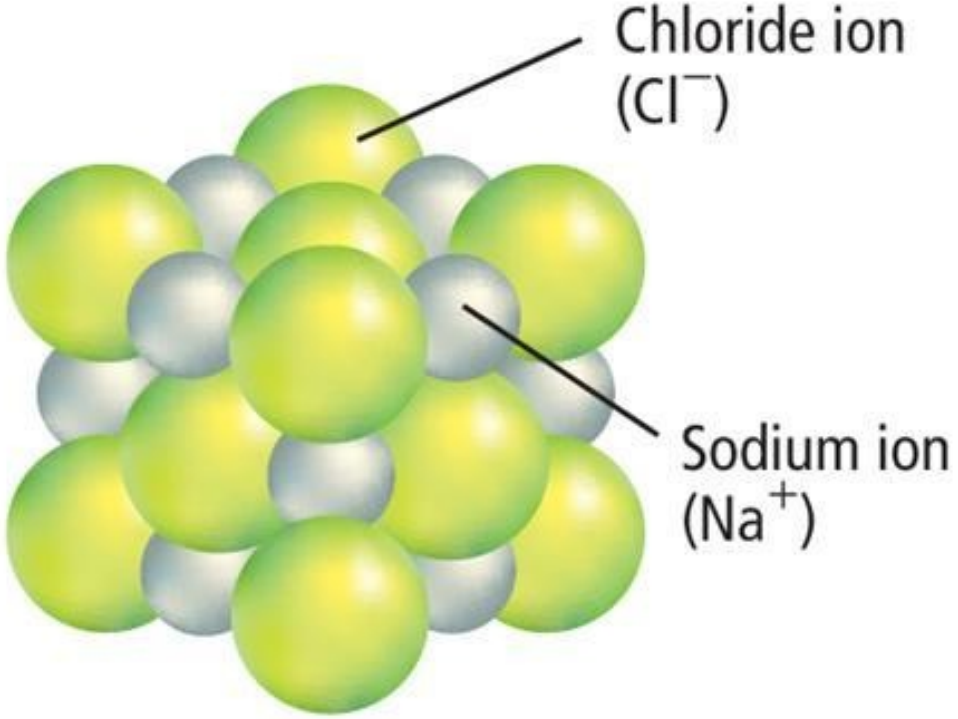


Properties of Ionic Compounds

- Chemical _____ in compounds determines many of its _____.
- Ionic _____ produce unique _____ structures for ionic _____.
    - Physical structures also contribute to physical _____ of ionic compounds.

Properties of Ionic Compounds

- **<u>Physical Structure</u>**
  - Ions arranged into _____ _____ pattern.
    - **ie~** _____ _____ (____ geometric arrangement).
    - Balances forces of _____ and _____ between _____.



Sodium chloride crystal

Properties of Ionic Compounds

- _____ properties depend on how strong the _____ are between _____.
  - _____ attractions occur between _____ ions & ions with _____ charge.

Physical Properties

- Ions locked into _____ positions by strong attractive forces are _____.
- Common physical properties include:
  - _____ _____
  - _____ _____
  - _____
  - Ability to _____ _____
    - Ionic compounds that are _____ in _____ and can conduct electricity are called _____,

Physical Properties

- Melting & boiling involves _____ electrostatic _____ and _____ ionic bonds.

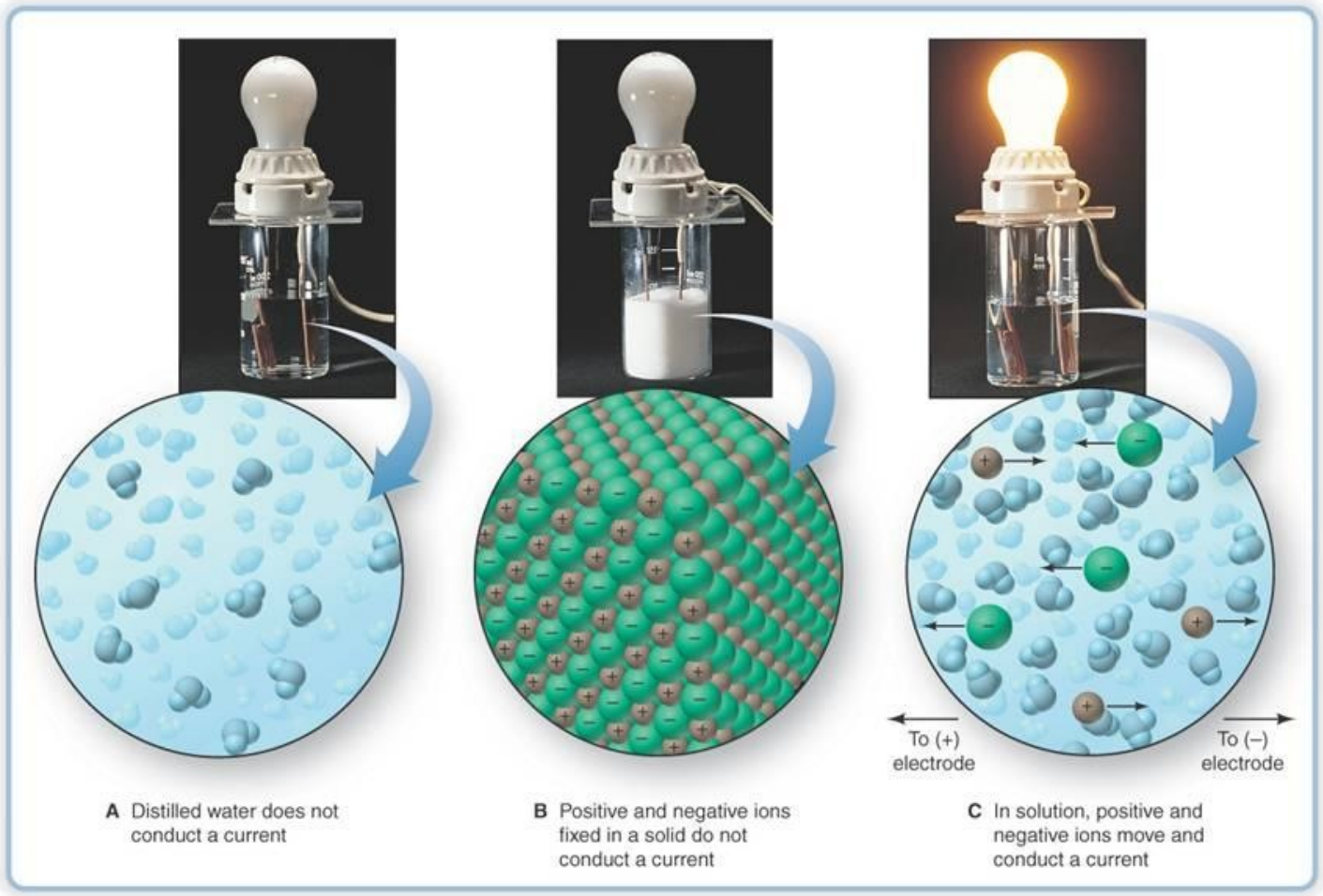
Table 7.5 Melting and Boiling Points of Some Ionic Compounds

Compound	Melting Point (°C)	Boiling Point (°C)
NaI	660	1304
KBr	734	1435
NaBr	747	1390
$CaCl_2$	782	>1600
NaCl	801	1413
MgO	2852	3600

Physical Properties

- In order to conduct electricity, a substance needs to have _____ particles _____ to move.
  - In a _____ state, compounds ____ _____ have charged particles _____ to move.
    - _____ in place
  - In _____ form (or _____ in water), _____ are free to move.

Physical Properties



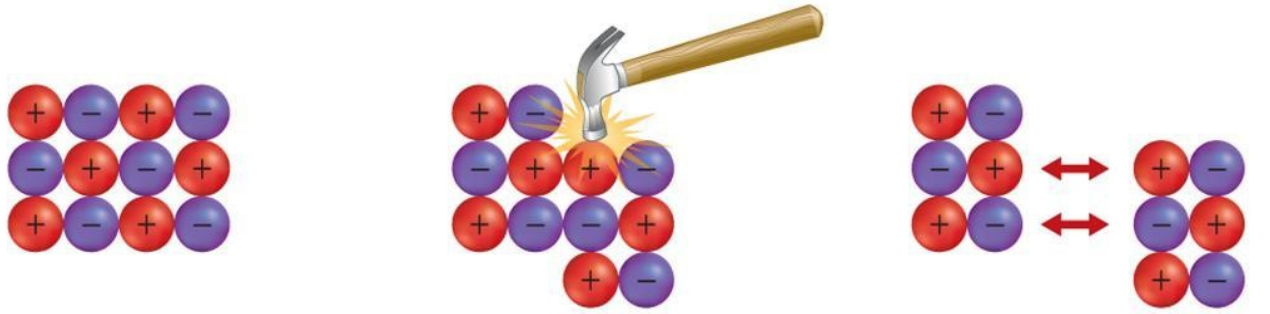
A Distilled water does not conduct a current

B Positive and negative ions fixed in a solid do not conduct a current

C In solution, positive and negative ions move and conduct a current

Physical Properties

- Ionic compounds are _____ & _____ b/c ions are _____ in a _____ _____.
  - Due to strong _____ forces that hold ions in place.



Undisturbed ionic crystal | Applied force realigns particles. | Forces of repulsion break crystal apart.

  - External _____ strong enough to overcome the attractive forces between ions cause the crystal to _____ or _____ apart.

Energy & the Ionic Bond

- Formation of ionic compounds from ions is an _____ _____ reaction.
  - Releases _____
  - Resulting compound is more _____ & _____ in energy than the individual _____.

Energy & the Ionic Bond

- Ionic compounds are _____ and arranged in a _____ _____.
  - Takes _____ to separate the _____ (_____ _____).
- _____ required to _____ ionic compounds apart is known as the _____ energy.
  - The _____ the attraction between ions, the _____ the lattice energy.

Energy & the Ionic Bond

- Lattice energy is directly related to the _____ of the ions.
  - _____ ions have _____ lattice energies.
    - **ie~** LiF vs KF
  - Ions with _____ charges have _____ lattice energies.
    - **ie~** $SrCl_2$ vs AgCl

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

Ionic Compounds & Metals

Names & Formulas For Ionic Compounds

Names & Formulas For Ionic Compounds

- **<u>Main Idea</u>**: In written _____ and _____ for ionic compounds, the _____ appears _____, followed by the _____.
  - **ie~** First and last names

Formulas For Ionic Compounds

- Ionic compounds are made up up ions arranged a _____ pattern.
- _____ formula for an ionic compound is called a _____ _____.
  - Represents simplest _____ of _____.
    - **ie~** $MgCl_2$
      - Ions exist in a _____ ratio
      - Formula unit contains _____ Mg^{2+} ion & _____ Cl^- ions
      - Overall charge is _____ b/c compound is electrical _____.

Formulas For Ionic Compounds

- **<u>Monatomic Ions</u>**
  - _____ ion (Mg^{2+} or Br^{-})
    - Charge of Group 2 ions? Group 15 ions?
  - _____ of monatomic ion known as _____ _____ (or state).
    - Equals the number _____ transferred from the _____ to form the _____.
      - Oxidation numbers for NaCl?
  - Most _____ metals have _____ than _____ oxidation number.

Formulas For Ionic Compounds

- **<u>Binary Ionic Compounds</u>** (_____ elements)
  - Chemical formula written with symbol of _____ first, followed by symbol of _____.
    - _____ represent the number _____ of each _____ present in the compound.
      - No subscript = _____ ion

Formulas For Ionic Compounds

- Chemical formula written with symbol of cation first, followed by symbol of anion.
  - Write the formulas and names for the compound formed from these pair of ions
    - Ba^{2+}, $^{S2-}$
    - Li^{+}, O^{2-}
    - Ca^{2+}, N^{3-}
    - Cu^{2+}, I^{-}

Formulas For Ionic Compounds

- Chemical formula written with symbol of cation first, followed by symbol of anion.
  - Write the formula for the following ionic compounds
    - sodium iodide
    - Tin (II) chloride
    - potassium sulfide
    - calcium iodide

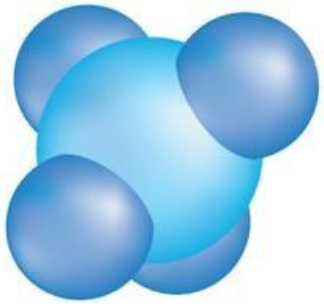
Formulas For Ionic Compounds

- **<u>Polyatomic Ionic Compounds</u>**
  - Ions made up of _____ than one _____.
    - Group of atoms that are bonded _____ and have a _____.
    - Act as an _____ atom
    - _____ applies to _____ group.
    - _____ of polyatomic ions _____ change.

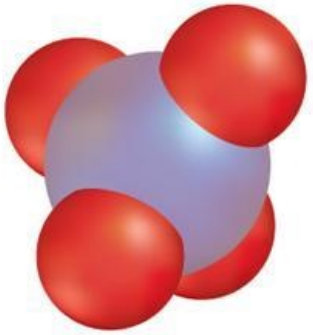
Ammonium	NH_4^+
Acetate	CH_3COO^-
Hydroxide	OH^-
Nitrate	NO^{3-}
Nitrite	NO^{2-}
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}
Carbonate	CO_3^{2-}
Phosphate	PO_4^{3-}

Formulas For Ionic Compounds

- **<u>Polyatomic Ionic Compounds</u>**
  - Use _____ to show polyatomic ions.
    - **Ammonium sulfate**
    - **Calcium phosphate**



Ammonium ion (NH_4^+)



Phosphate ion (PO_4^{3-})

Formulas For Ionic Compounds

- **<u>Practice Writing Polyatomic Ionic Compounds</u>**
  - Sodium nitrate _____
  - Sodium carbonate_____
  - Magnesium nitrate_____
  - Calcium hydroxide_____
  - Copper (II) acetate_____
  - Cobalt (III) sulfate_____

Formulas For Ionic Compounds

- **<u>Practice Writing Polyatomic Ionic Compounds</u>**
  - Ammonium phosphate_____
  - Ammonium sulfide_____
  - Na_2SO_4 _____
  - $MgCO_3$_____
  - $Fe(NO_3)_2$ _____
  - $CrPO_4$ _____
  - $Ca(OH)_2$ _____

Rules For Naming Ionic Compounds

- Name the _____ followed by the _____.
- For monatomic ions, use the _____ name.
- For monatomic ions, use the _____ of the element name plus the suffix _____.
  - **ie~**
- When a compound contains a polyatomic ion, name the _____ followed by the _____ ion.
  - **ie~**

Ionic Compounds & Metals

Metallic Bonds & Properties of Metals

Names & Formulas For Ionic Compounds

- **<u>Main Idea</u>**: _____ form _____ _____ and can be modeled as _____ surrounded by freely _____ valence _____.

Metallic Bonds

- _____ share several properties with _____ bonds.
  - _____ in both is based on _____ between particles of _____ charges.
  - Pattern causes _____ to form _____ in the _____ state.

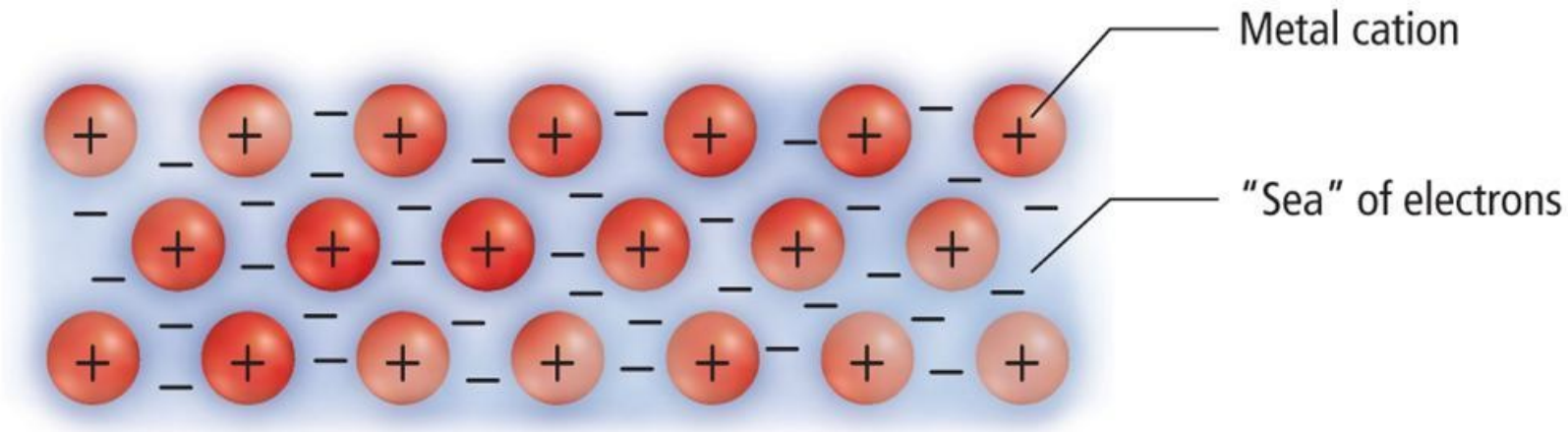
Metallic Bonds

- _____ energy levels of metal _____ _____.
  - Described by the "_____ _____ model"
    - _____ metal atoms contribute their _____ _____ to form a "_____" of electrons.
    - Valence electrons are _____ to _____ and do not stick around _____ particular atom.
      - Move easily from one atom to the next.
      - Referred to as _____ _____.

Metallic Bonds

- Metallic _____ form when the atom's _____ electrons move freely throughout the _____.

- Metallic _____ is the _____ of a metallic _____ for _____ _____.



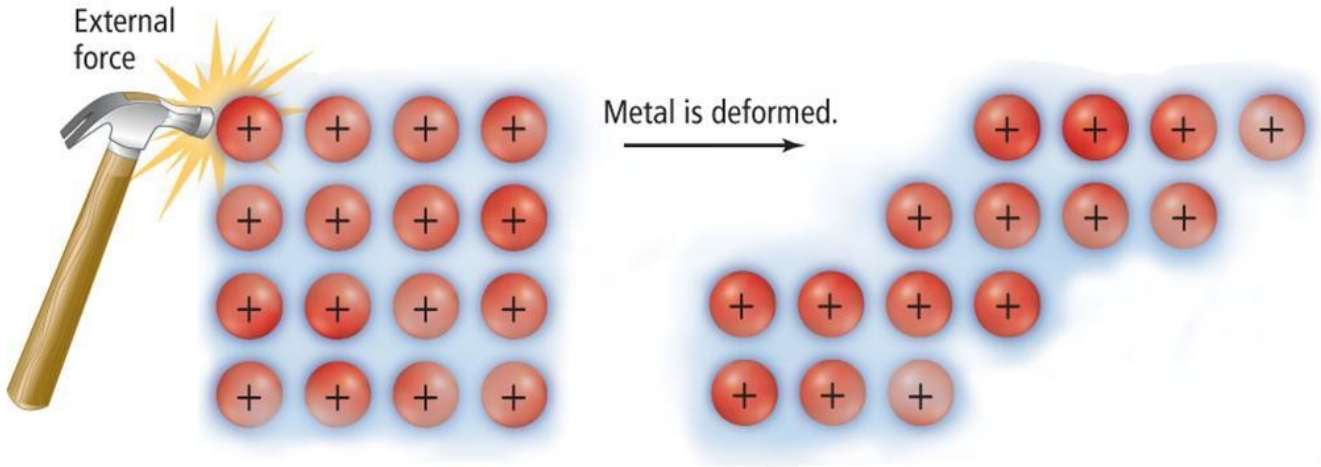
Properties of Metals

- _____ properties explained by _____ _____.
- **Melting & Boiling Points**
  - Metals have moderately _____ melting and boiling points.
  - _____ _____

Table 7.12	Melting and Boiling Points	
Element	Melting Point (°C)	Boiling Point (°C)
Lithium	180	1347
Tin	232	2623
Aluminum	660	2467
Barium	727	1850
Silver	961	2155
Copper	1083	2570

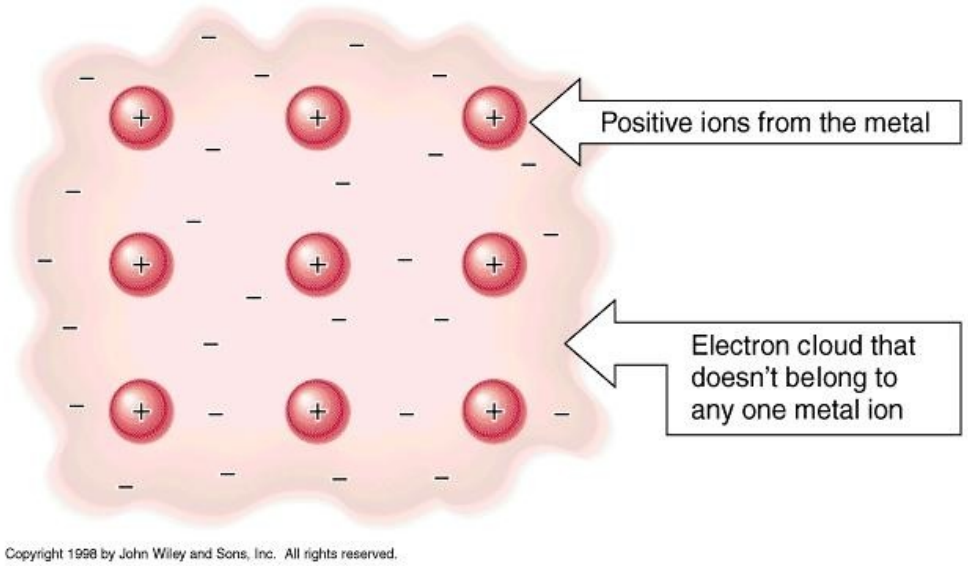
Properties of Metals

- Metals are _____
  - Can be hammered into _____ _____.
- Metals are _____
  - Can be drawn into _____ _____.



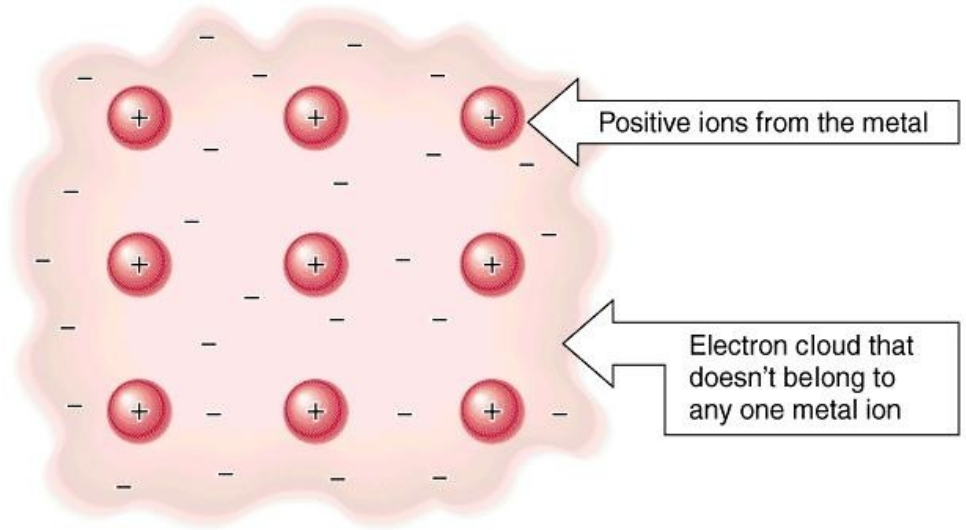
Properties of Metals

- Metals are _____ conductors of _____ and _____.
  - Due to _____ of _____ electrons around _____ metallic _____.
- Also creates property of _____ in metals.



Properties of Metals

- **<u>Hardness and Strength</u>**
  - _____ as the number of delocalized electrons _____.
  - _____ metals have _____ metallic bonds
  - _____ metals are considered "_____" due to only _____ delocalized electron.



Properties of Metals

- Metals don't actually form _____.
  - Form _____ instead.
    - _____ of elements that has _____ properties.
    - Unique _____ of properties allows alloys to have a _____ range of _____ applications.

Table 7.13 Commercial Alloys

Common Name	Composition	Uses
Alnico	Fe 50%, Al 20%, Ni 20%, Co 10%	magnets
Brass	Cu 67–90%, Zn 10–33%	plumbing, hardware, lighting
Bronze	Cu 70–95%, Zn 1–25%, Sn 1–18%	bearings, bells, medals
Cast iron	Fe 96–97%, C 3–4%	casting
Gold, 10-carat	Au 42%, Ag 12–20%, Cu 37.46%	jewelry
Lead shot	Pb 99.8%, As 0.2%	shotgun shells
Pewter	Sn 70–95%, Sb 5–15%, Pb 0–15%	tableware
Stainless steel	Fe 73–79%, Cr 14–18%, Ni 7–9%	instruments, sinks
Sterling silver	Ag 92.5%, Cu 7.5%	tableware, jewelry