Ch. 6 The Periodic Table

• Topic 1: Organizing the Elements (p. 155-160)
• Topic 2: Classifying the Elements (p. 161-169)
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Döbereiner's Triads

Three (3) elements with similar properties; one element's properties fell "midway" between the other two.

Newlands' Law of Octaves

"Any given element will exhibit analogous behavior to the eighth element following it in the table."

Mendeleev's Periodic Table

"The properties of the elements are in periodic dependence upon their atomic weights."

Published 1st table of elements, arranged by mass. Groups, or families, have similar properties. Led to the discovery of unknown elements.

Periodic Law

Henry Moseley:
• assigned atomic numbers to elements

Periodic Law

"When the elements are arranged in order of increasing atomic number, there is a periodic pattern in their chemical and physical properties."

Intro to the Periodic Table

Horizontal rows ("periods"), numbered 1 – 7.

Vertical groups ("families") of elements share similar properties, numbered 1 – 18.
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Shielding - core e-block the attraction between the nucleus and the valence

A greater number of protons in the nucleus exert a greater attraction on valence e, pulling them closer to the nucleus.

Orbitals of higher energy are farther from the nucleus.

**Atomic Radius**

Which has a greater atomic size, **C or O?**

C has a greater atomic size than O, according to the left-to-right trend in atomic size.

Which has a greater atomic size, **Li or K?**

K has a greater atomic size than Li, according to the top-down trend in atomic size.

Which has a greater atomic size, **C or Al?**

Al has a greater atomic size than C, according to both the left-to-right trend and top-down trend in atomic size.

Which has a greater atomic size, **Se or I?**

Here we can’t tell which has a greater atomic size: I would be greater according to the top-down trend, but Se would be greater according to the left-right trend. The effects tend to cancel.
Ionic Radius

http://www.youtube.com/watch?v=hkyxQjKwBU4&feature=related

Cations (+)
- lose e⁻
- smaller r

Anions (–)
- gain e⁻
- larger r

Examples

Which atom has the higher 1st I.E.?

N or Bi

Ba or Ne

Which particle has the larger radius?

S or S²⁻

Al or Al³⁺
Elements within a group will form ions of the same charge because they have the same number of valence electrons.
Metallic Character & the P.T.

Elements within a group will form ions of the same charge because they have the same number of valence electrons.

Metallic character decreases as you move to the right across a period, and increases as you move down a column.

http://www.youtube.com/watch?v=bbuVzNus0A

Which is more metallic, Sn or Te?

Sn is more metallic than Te, according to the left-to-right trend in metallic character.

(a)

Which is more metallic, Si or Sn?

Sn is more metallic than Si, according to the top-down trend in metallic character.

(b)

Which is more metallic, Br or Te?

Te is more metallic than Br, according to both the top-down and the left-to-right trend in metallic character.

(c)

Which is more metallic, Se or I?

Here we can’t tell which has a greater metallic character: I would be more metallic according to the top-down trend, but Se would be more metallic according to the left-right trend. The effects tend to cancel.

(d)
Ionization Energy

http://www.youtube.com/watch?v=6e4uoWQeM4s&feature=related

1\textsuperscript{st} Ionization Energy Trend

Ionization energy increases as you move to the right across a period, and decreases as you move down a column.

http://www.youtube.com/watch?v=8F9nA4Fg3Rw&feature=related

Ionization Energy

Opposite of atomic radius:
In small atoms, e\textsuperscript{-} are close to the nucleus where the attraction is stronger

Why small jumps within each group?
Stable e\textsuperscript{-} configurations don’t want to lose e\textsuperscript{-}

Which has the higher ionization energy, Mg or P?
P has a higher ionization energy than Mg. P is closer to a noble gas configuration.

Which has the higher ionization energy, As or Sb?
As has a higher ionization energy than Sb. Electrons in high energy orbitals are held less strongly than low energy orbitals.

Which has the higher ionization energy, N or Si?
N has a higher ionization energy than Si, according to the top-down and left-right trend for ionization energy.
**Successive Ionization Energies**

Large jumps occur when a CORE electron is removed.

**Mg**

| 1st I.E. | 736 kJ |
| 2nd I.E. | 1,445 kJ |
| Core e⁻ | 3rd I.E. | 7,730 kJ |

**Ionization Energy**

**Successive Ionization Energies**

Large jumps occur when a CORE electron is removed.

**Al**

| 1st I.E. | 577 kJ |
| 2nd I.E. | 1,815 kJ |
| 3rd I.E. | 2,740 kJ |
| Core e⁻ | 4th I.E. | 11,600 kJ |

**Melting/Boiling Point**

Highest in the middle of a period.

**Examples**

Which atom has the higher melting/boiling point?

- Li or C: C
- Cr or Kr: Cr