Chapter 14
Chemical Periodicity

Adapted from notes by Stephen Cotton

Section 14.1
Classification of the Elements

**OBJECTIVES:**
- Explain why you can infer the properties of an element based on those of other elements in the periodic table.
- Use electron configurations to classify elements as noble gases, representative elements, transition metals, or inner transition metals.

Mendeleev’s Table
- Grouped elements in columns by similar properties in order of
- Found some inconsistencies - felt that the mass were more important than the mass, so switched order.
- Also found some.
- Must be elements.
- Predicted their before they were found.

The modern table
- Elements are still grouped by.
- Similar properties are in the same.
- Order is by.
- Added the noble gases – Mendeleev didn’t know about them because they didn’t with anything.

- Horizontal rows are called
- Also called
- Similar properties within a
The elements in the A groups are called the outer filling. The group B are called the Inner transition elements... belong after element 57 and element 89.

Group 1A are the Group 2A are the Group 7A are called the Group 8A are the

Why are there similar properties within a group of elements?
- The outermost orbital(s) electron configuration.
- The properties of atoms repeat because the physical and chemical properties of an atom depend primarily upon the.
OBJECTIVES:

• Interpret group trends in atomic radii, ionic radii, ionization energies, and electronegativities.

• Interpret period trends in atomic radii, ionic radii, ionization energies, and electronegativities.
**Atomic Radius**

- **Atomic Radius =**

**Trends in Atomic Size**

- **Influenced by three factors:**
  1. Energy Level
  2. Charge on nucleus
  3. Shielding effect

**Shielding**

- The electron on the outermost energy level has to “look” through all the other energy levels to “see” the nucleus.
- Results in less from the nucleus.
- Which then results in the expansion of the atom.

**Group trends**

- As you go down a... each atom has another.
- So the atoms get...

**Periodic Trends**

- As you go across a... the radius gets...
- 1 more e· and 1 more p·
- Outermost electrons “pulled”
Trends in Ionization Energy

- I.E. – the amount of energy required to completely remove an electron from a gaseous atom.
- The energy required to remove the electron is called the first ionization energy.
- The second I.E. is the energy required to remove the second electron.
- Always greater than the first I.E.
- The third I.E. is the energy required to remove a third electron.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>1312</td>
<td></td>
<td></td>
</tr>
<tr>
<td>He</td>
<td>2731</td>
<td>5247</td>
<td></td>
</tr>
<tr>
<td>Li</td>
<td>520</td>
<td>7297</td>
<td>11810</td>
</tr>
<tr>
<td>Be</td>
<td>900</td>
<td>1757</td>
<td>14840</td>
</tr>
<tr>
<td>B</td>
<td>800</td>
<td>2430</td>
<td>3569</td>
</tr>
<tr>
<td>C</td>
<td>1086</td>
<td>2352</td>
<td>4619</td>
</tr>
<tr>
<td>N</td>
<td>1402</td>
<td>2857</td>
<td>4577</td>
</tr>
<tr>
<td>O</td>
<td>1314</td>
<td>3391</td>
<td>5301</td>
</tr>
<tr>
<td>F</td>
<td>1681</td>
<td>3375</td>
<td>6045</td>
</tr>
<tr>
<td>Ne</td>
<td>2080</td>
<td>3963</td>
<td>6276</td>
</tr>
</tbody>
</table>

Table 14.1, p. 402

Ionization Energy

- The second I.E. is the energy required to remove the electron.
- Always greater than the first I.E.
- The third I.E. is the energy required to remove a third electron.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>1312</td>
<td></td>
<td></td>
</tr>
<tr>
<td>He</td>
<td>2731</td>
<td>5247</td>
<td></td>
</tr>
<tr>
<td>Li</td>
<td>520</td>
<td>7297</td>
<td>11810</td>
</tr>
<tr>
<td>Be</td>
<td>900</td>
<td>1757</td>
<td>14840</td>
</tr>
<tr>
<td>B</td>
<td>800</td>
<td>2430</td>
<td>3569</td>
</tr>
<tr>
<td>C</td>
<td>1086</td>
<td>2352</td>
<td>4619</td>
</tr>
<tr>
<td>N</td>
<td>1402</td>
<td>2857</td>
<td>4577</td>
</tr>
<tr>
<td>O</td>
<td>1314</td>
<td>3391</td>
<td>5301</td>
</tr>
<tr>
<td>F</td>
<td>1681</td>
<td>3375</td>
<td>6045</td>
</tr>
<tr>
<td>Ne</td>
<td>2080</td>
<td>3963</td>
<td>6276</td>
</tr>
</tbody>
</table>

Trends in Electron Affinity

- The energy change associated with electron affinity to a gaseous atom.
- Easiest to add to group.
- Gets them to full.
- Increases.
- Decreases.

Trends in Ionic Size

- Cations form by losing electrons.
- Cations are smaller than the atom they come from.
Ionic size

- Anions form by ________ electrons.
- Anions are _____ than the atom they come from.

Configuration of Ions

- Ions usually have ________ configurations.
  - Na:
    - Na$^{1+}$:
    - F$^{-}$:

Size of Isoelectronic ions

- Iso –
- Iso electronic ions have the same # of
- Al$^{3+}$ Mg$^{2+}$ Na$^{1+}$ Ne F$^{-}$ O$^{2-}$ and N$^{3-}$
- all have ________ electrons
- all have the configuration:

Size of Isoelectronic ions

- Positive ions that have more protons would be smaller due to more on the electrons. Negative ions have more electrons so more forces.

Electronegativity

- The tendency for an atom to _____ electrons to itself when it is ________ with another element.
- How fair is the sharing?
- Big electronegativity means it the electron _____ it.

Group Trend

- The further down a group, the the outermost electron is , and the electrons an atom has.
- More willing to ________ electrons
- ________ electronegativity.
Periodic Trend

- are at the left of the table.
- They let their electrons go
- electronegativity.
- At the right end are the
- They want electrons.
- Try to take them away from
- electronegativity.

Ionization energy, electronegativity, and electron affinity

Atomic size and ionic size