Chapter 8

III. Trends in Atomic Properties

A. Effective Nuclear Charge (Z_{eff})

The amount of positive charge experienced by the valence electrons of an atom/ion

for neutral atoms:

1. Down a group: Constant, and approximately equal to the number of valence e^-'s
   eg $Z_{eff}(Li) = Z_{eff}(Na) = \ldots = 1$
   * core electrons "shield" or "screen" valence electrons from nucleus *
2. Across a period: Increases
   * Valence e^-'s can't shield each other *

B. Atomic and Ionic Radii (average size)

1. Measure size with light!
   Ionic Compounds - x-rays
   Covalent Compounds - microwaves

2. Across a period:

3. Down a group:

4. Ionic Radii:

C. Ionization Energy (IE)

$M_{(g)} \rightarrow M^+_{(g)} + e^-$ $\quad \Delta E_{rxn} \equiv IE_1(M)$

$M^+_{(g)} \rightarrow M^{2+}_{(g)} + e^-$ $\quad \Delta E_{rxn} \equiv IE_2(M)$

etc.

1. <u>Across a period</u> ...

2. <u>Down a group</u> ...

Reaction of $H_2O_{(\ell)}$ with ...

$Mg_{(s)} + 2H_2O_{(\ell)} \rightarrow Mg^{2+}_{(aq)} + 2OH^-_{(aq)} + H_{2(g)}$

$2Na_{(s)} + 2H_2O_{(\ell)} \rightarrow 2Na^+_{(aq)} + 2OH^-_{(aq)} + H_{2(g)}$

$2K_{(s)} + 2H_2O_{(\ell)} \rightarrow 2K^+_{(aq)} + 2OH^-_{(aq)} + H_{2(g)}$

[not on Test 2!]

D. Electron Affinity (EA)

$X_{(g)} + e^- \rightarrow X^-_{(g)}$ $\Delta E_{rxn} \equiv EA(X)$

If X^- is more stable than X, $EA < 0$

(consistent with atomic spectroscopy sign convention)

* Very rough trends *

1. Most negative EA's: Group 7A

2. Second most negative EA's: Group 6A

3. $EA > 0$ for Groups 2A and 8A