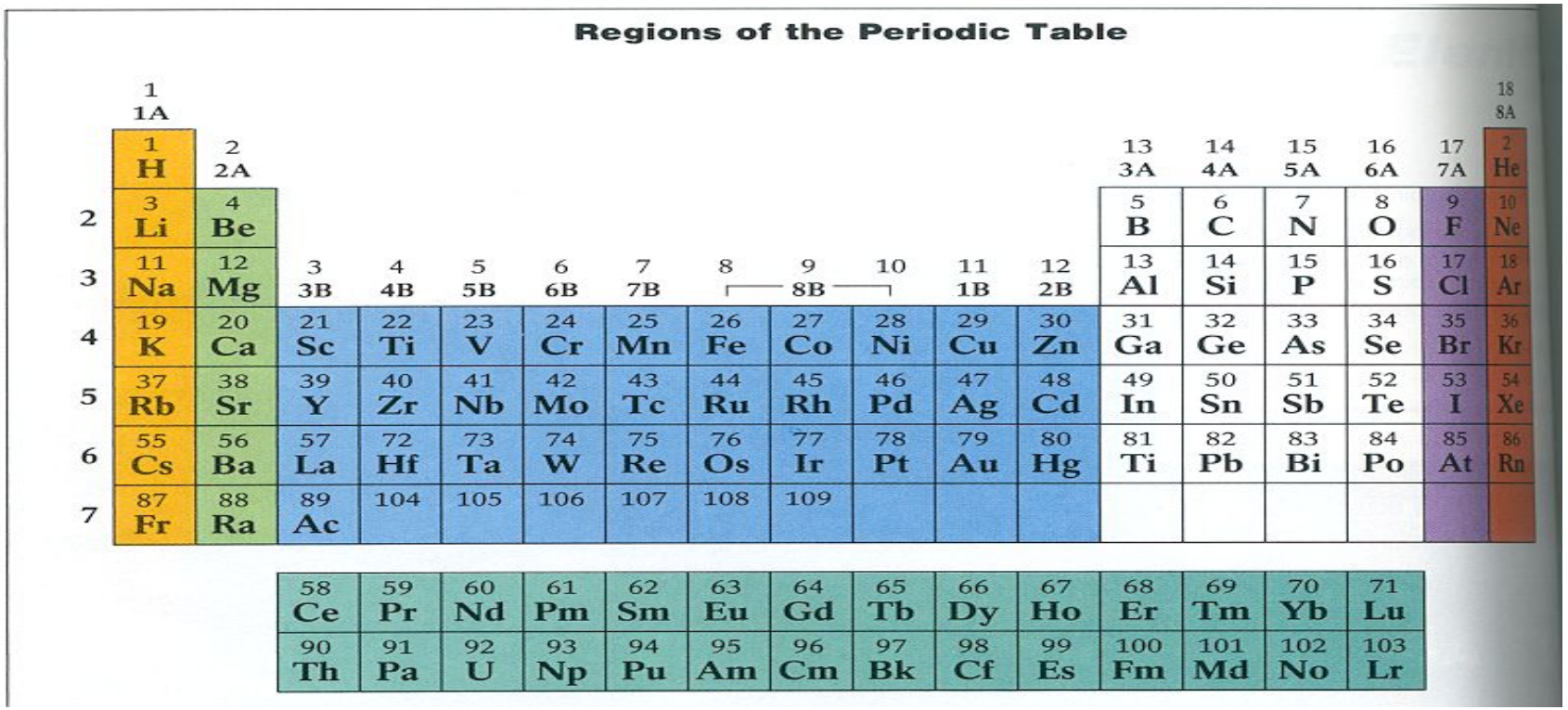
Periodic Table & Trends

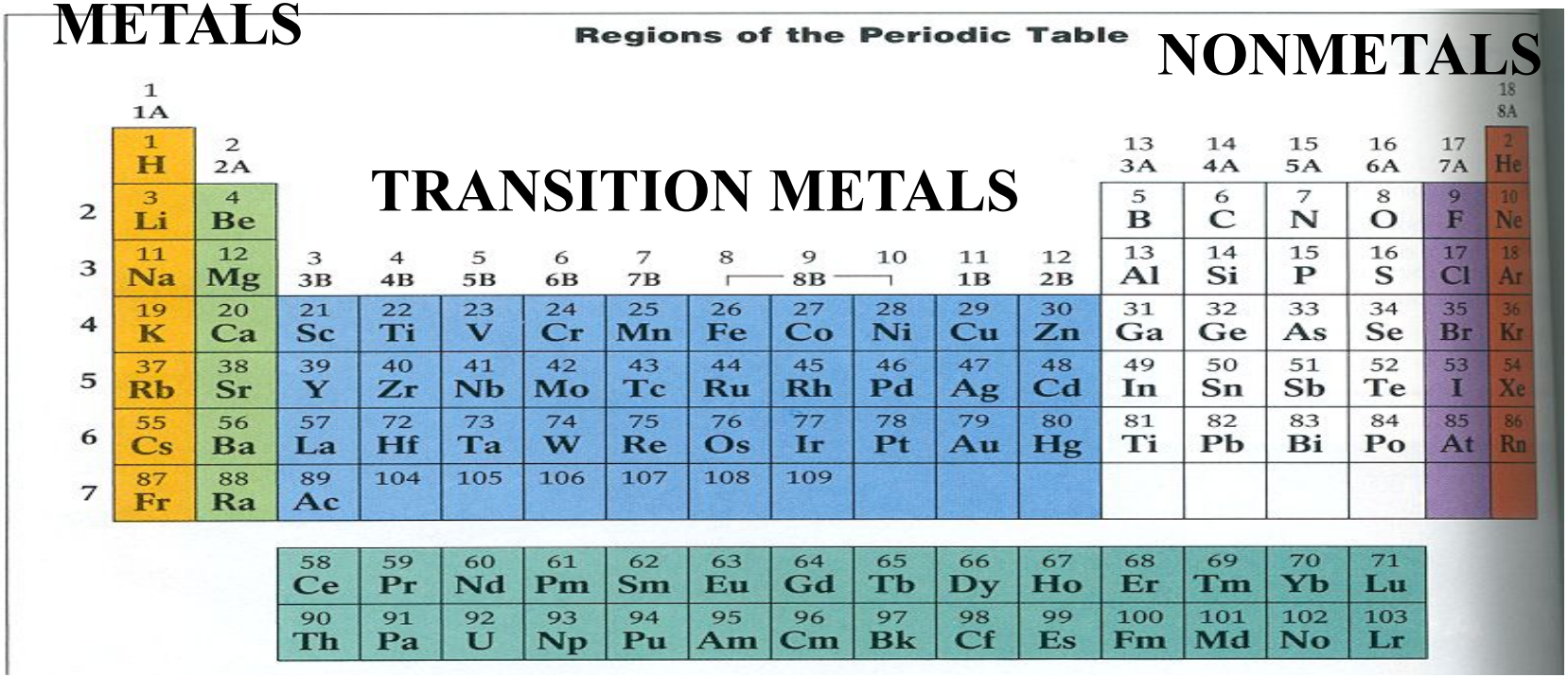


History of the Periodic Table

- 1871 – Mendeleev arranged the elements according to: 1. Increasing atomic mass 2. Elements w/ similar properties were put in the same row
- 1913 – Moseley arranged the elements according to: 1. Increasing atomic number 2. Elements w/ similar properties were put in the same column

Group Names

Alkali +1	Alkaline Earth Metals +2		+3		-3	-2	Halogen -1	Noble Gases 0
H 1								He 2
Li 3	Be 4		B 5	C 6	N 7	O 8	F 9	Ne 10
Na 11	Mg 12		Al 13	Si 14	P 15	S 16	Cl 17	Ar 18



S & P block – Representative Elements

Metalloids (Semimetals, Semiconductors) – B,Si, Ge, As, Sb, Te (properties of both metals & nonmetals)

Columns – groups or families Rows - periods

Periodic Groups

- Elements in the same column have similar chemical and physical properties

- These similarities are observed because elements in a column have similar e^- configurations (same amount of electrons in outermost shell)

Periodic Trends

- Periodic Trends – patterns (don't always hold true) can be seen with our current arrangement of the elements (Moseley)

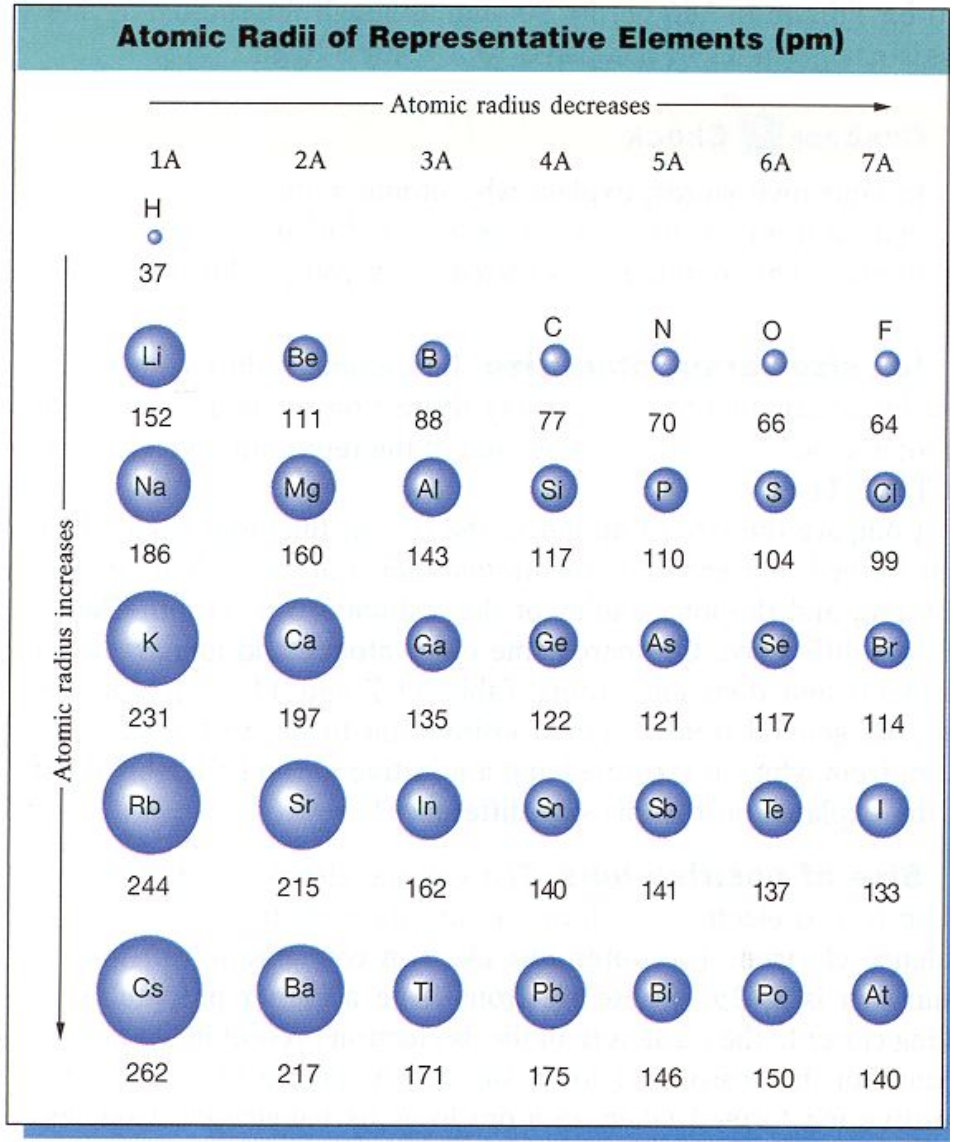
- Trends we'll be looking at:

1. Atomic Radius
2. Ionization Energy
3. Electronegativity

Atomic Radius

TABLE 11-7

Atomic Radii of Representative Elements (pm)



- Atomic Radius – size of an atom (distance from nucleus to outermost e^-)

Atomic Radius Trend

- Group Trend – As you go down a column, atomic radius increases

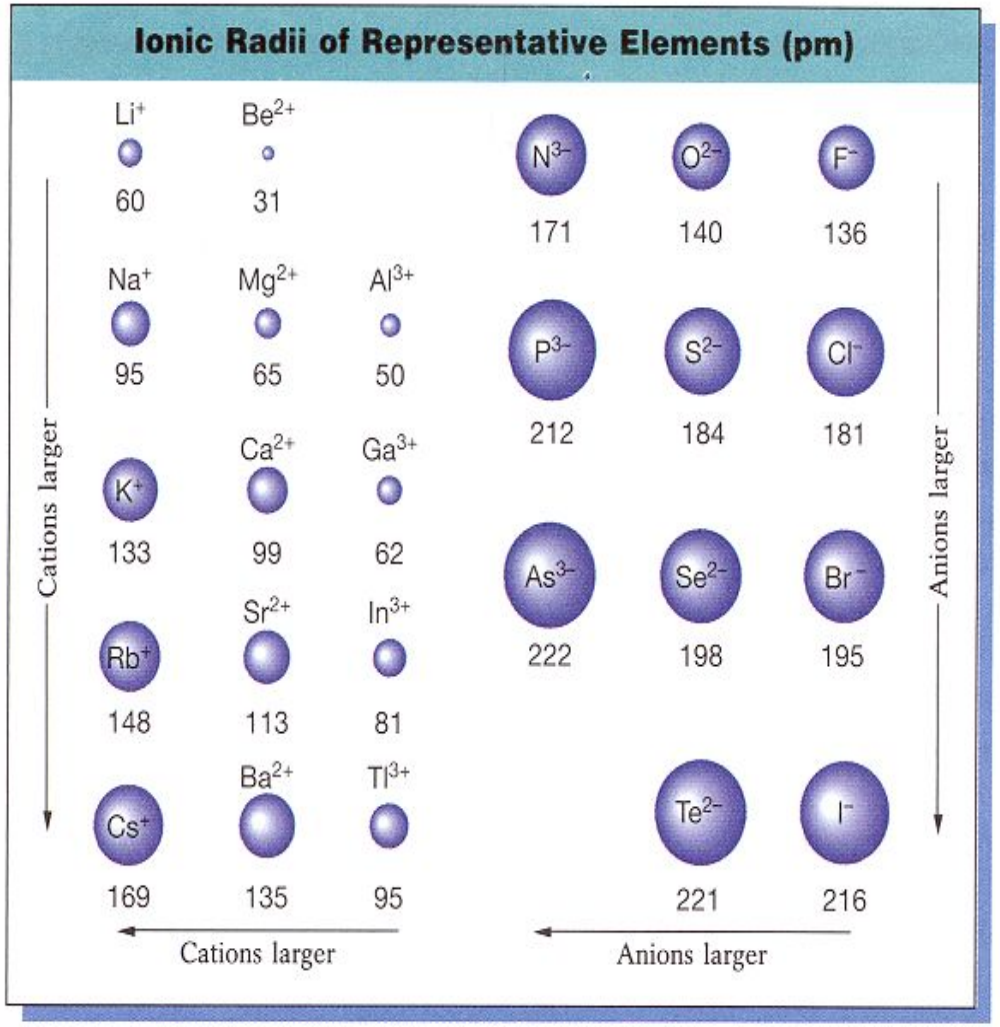
As you go down, e^- are filled into orbitals that are farther away from the nucleus (attraction not as strong)

- Periodic Trend – As you go across a period (L to R), atomic radius decreases

As you go L to R, e^- are put into the same orbital, but more p^+ and e^- total (more attraction = smaller size)

Ionic Radius

TABLE 11-8



- Ionic Radius – size of an atom when it is an ion

Ionic Radius Trend

Metals – lose e^-, which means more p^+ than e^- (more attraction) SO…

Cation Radius < Neutral Atomic Radius

Nonmetals – gain e^-, which means more e^- than p^+ (not as much attraction) SO…

Anion Radius > Neutral Atomic Radius

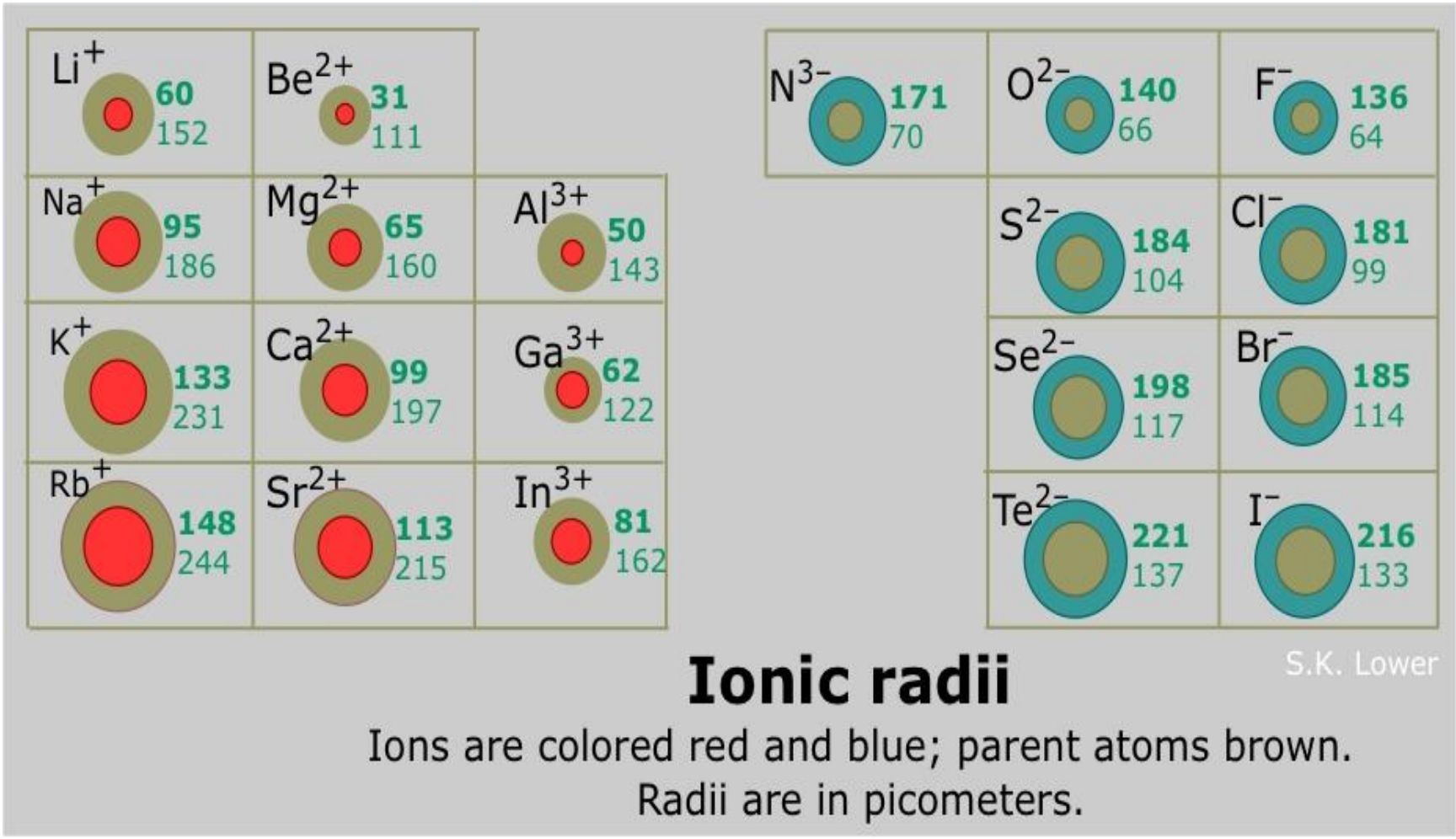
Ionic Radius Trend

- Group Trend – As you go down a column, ionic radius increases
- Periodic Trend – As you go across a period (L to R), cation radius decreases,

  anion radius decreases, too.

As you go L to R, cations have more attraction (smaller size because more p^+ than e^-). The anions have a larger size than the cations, but also decrease L to R because of less attraction (more e^- than p^+)

Ionic Radius



Ionic Radius

How do I remember this?????

The more electrons that are lost, the greater the reduction in size.

Li^{+1}	**Be^{+2}**
protons 3	protons 4
electrons 2	electrons 2

Which ion is smaller?

Ionic Radius

How do I remember this???

The more electrons that are gained, the greater the increase in size.

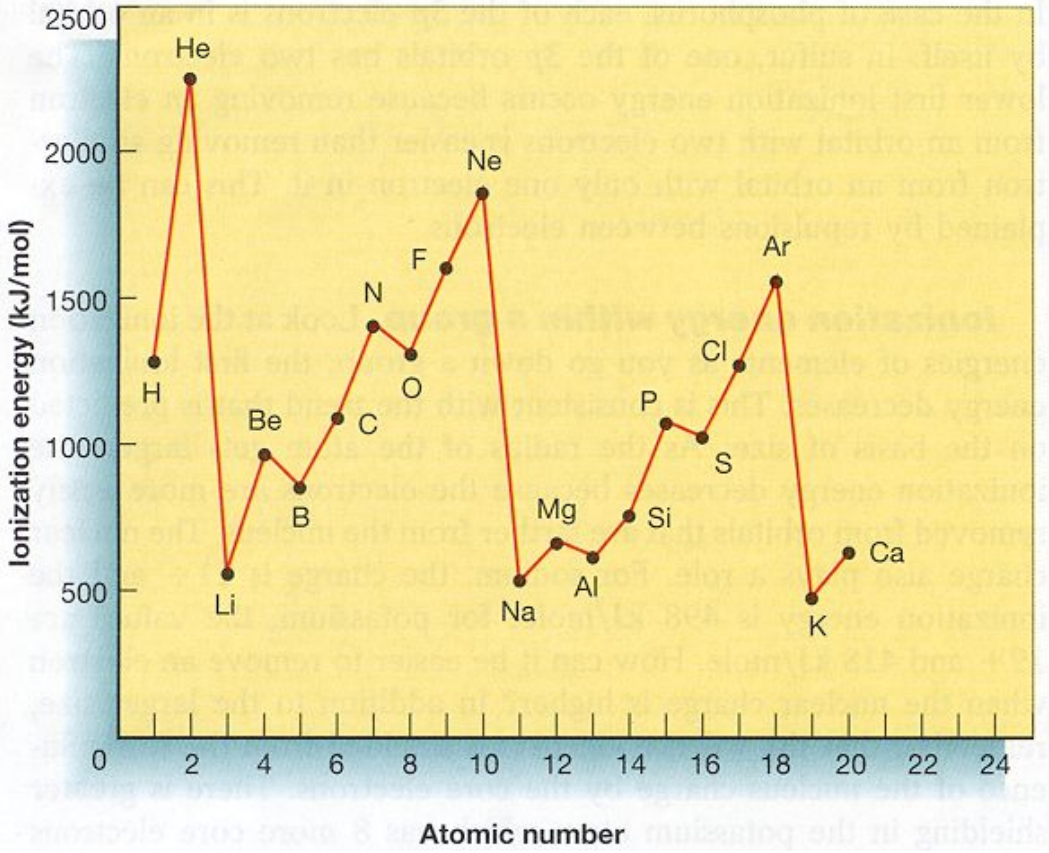
P^{-3} S^{-2}

protons 15 protons 16

electrons 18 electrons 18

Which ion is smaller?

Ionization Energy



- Ionization Energy – energy needed to remove outermost e^-

Ionization Energy

- Group Trend – As you go down a column, ionization energy decreases

As you go down, atomic size is increasing (less attraction), so easier to remove an e^-

- Periodic Trend – As you go across a period (L to R), ionization energy increases

As you go L to R, atomic size is decreasing (more attraction), so more difficult to remove an e^-

(also, metals want to lose e^-, but nonmetals do not)

Electronegativity

Table 14.2

Electronegativity Values for Atoms of Selected Elements						
H 2.1						
Li 1.0	Be 1.5	B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2	Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.8	Ca 1.0	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8
Rb 0.8	Sr 1.0	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5
Cs 0.7	Ba 0.9	Tl 1.8	Pb 1.9	Bi 1.9		

- Electronegativity- tendency of an atom to attract e^-

Electronegativity Trend

- Group Trend – As you go down a column, electronegativity decreases

As you go down, atomic size is increasing, so less attraction to its own e^- and other atom's e^-

- Periodic Trend – As you go across a period (L to R), electronegativity increases

As you go L to R, atomic size is decreasing, so there is more attraction to its own e^- and other atom's e^-

Reactivity

- Reactivity – tendency of an atom to react
- Metals – lose e^- when they react, so metals' reactivity is based on lowest Ionization Energy (bottom/left corner) Low I.E = High Reactivity
- Nonmetals – gain e^- when they react, so nonmetals' reactivity is based on high electronegativity (upper/right corner)

High electronegativity = High reactivity

Metallic Character

- Properties of a Metal – 1. Easy to shape
2. Conduct electricity 3. Shiny

- Group Trend – As you go down a column, metallic character increases
- Periodic Trend – As you go across a period (L to R), metallic character decreases (L to R, you are going from metals to non-metals