

AP Chapter 7 – Periodic Properties of the Elements

The Periodic Table of Meat

1 B  Bacon																	2 H  Hamburger										
Red Meat Seafood The Noble Meats Cold Cuts Steaks Gamey Poultry Mixed																		plantedbeans 									
3 P  Pork chops	4 Bb  Baby back ribs																	5 Bk  Blackened fish	6 Gf  Grilled fish	7 Bf  Baked fish	8 Ff  Fried fish	9 Mb  Meatballs	10 Sg  Sausage				
11 Pl  Pork loin	12 Sr  Spare ribs																	13 Sh  Sashimi	14 Im  Shrimp	15 Sl  Shellfish	16 Sq  Squid	17 Ci  Chili	18 Sj  Sloppy joe				
19 Cu  Pork cutlet	20 Hh  Hamhock	21 Ha  Sliced ham	22 Ca  Capicola	23 Cd  Corned beef	24 Tp  Beef tri-tip	25 Bs  Beef sausage	26 R  Beef ribs	27 Kb  Kobe	28 Rt  Pot roast	29 Cr  Crab	30 Tu  Tuna	31 Lb  Lobster	32 Pg  Chicken parmigiana	33 Tm  Chicken tempura	34 Fg  Chicken fingers	35 Ng  Chicken nuggets	36 Fr  Fried chicken										
37 Ro  Pork roast	38 Cz  Chorizo	39 Ch  Christmas ham	40 Mr  Mortadella	41 Rb  Roast beef	42 He  Head cheese	43 Td  Beef tenderloin	44 S  T-bone steak	45 Fm  Filet Mignon	46 Sf  Stroganoff	47 St  Beef stew	48 Cb  Chicken cordon bleu	49 C  Grilled chicken	50 Gt  General Tso's chicken	51 Ty  Teriyaki chicken	52 Jm  Jamaican jerk	53 W  Buffalo wings	54 Q  BBQ chicken										
55 Pp  Pulled pork	56 Ap  Al pastor	57 Z  Zungenwurst	58 Rs  Prosciutto	59 Pm  Pastrami	60 Cw  Cow tongue	61 Pr  Pepper steak	62 Tt  Steak Tartare	63 Si  Strip steak	64 Md  Mandarin beef	65 Bt  Brisket	66 Cs  Chicken casserole	67 Re  Rotisserie chicken	68 Tr  Tandoori	69 K  Kabobs	70 Gb  Gumbo	71 Sp  SPAM	72 Pe  Pepperoni										
73 Gr  Ground pork	74 Ct  Carnitas	75 Fe  Pig's feet	76 Pt  Pancetta	77 Gy  Gyro	78 Fi  Steak fingers	79 Sy  Salisbury steak	80 Cf  Chicken fried steak	81 Ry  Ribeye	82 Sw  Shawarma	83 J  Beef jerky	84 D  Duck	85 Th  Thanksgiving turkey	86 T  Sliced turkey	87 Sm  Summer sausage	88 Bg  Bologna	89 Lf  Pimento loaf	90 Hd  Hot dogs										

Key Meat Facts:

- Bacon is the "meat of life." Without bacon, life on earth as we know it could not exist
- Noble Meats are named as such because they rate the highest on the Glanburg "Yumminess Scale." Lowest-ranking meats include Pig's feet, Spam and Roadkill
- Meats occur in two basic forms: boned and boneless
- Basic chemical formulas: H₂B = Bacon Double Cheeseburger; ThReD = Turducken; HaRbT = Cold Cut Trio; HdQH = A Barbeque, FrCiB = Heart attack

91 Bn Bison	92 Ek Elk	93 L Lamb	94 Go Goat	95 Kl Roadkill	96 Bh Bushmeat
97 Dr Deer	98 Ra Rabbit	99 Wb Wild boar	100 O Ostrich	101 E Emu	102 G Gator

Jennie L. Borders

Section 7.1 – Development of the Periodic Table

- The periodic nature of the table arises from the repeating patterns in the electron configurations of the elements.
- Elements in the same column of the table contain the same number of valence electrons.

	$\dot{\text{X}}$	Valence electrons						Noble	
1 Ring -->	H	$\dot{\text{X}}$	$\dot{\text{X}}$	$\dot{\text{X}}$	$\dot{\text{X}}$	$\dot{\text{X}}$	$\dot{\text{X}}$	$\ddot{\text{X}}$	<-- He
2 Rings -->	Li	Be	B	C	N	O	F	$\ddot{\text{X}}$	<-- Ne
3 Rings -->	Na	Mg	Al	Si	P	S	Cl	$\ddot{\text{X}}$	<-- Ar
4 Rings -->	K	Ca	3	4	5	6	7	8	
	1	2	Valence electrons						

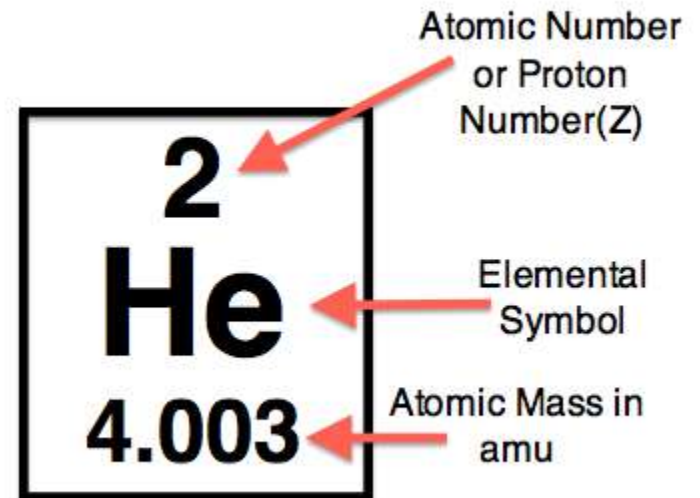
Mendeleev's Table

- Mendeleev created the “first” periodic table by arranging the elements with increasing atomic weight.
- Mendeleev predicted properties of undiscovered elements based on their location on his periodic table.

			Ti = 50	Zr = 90	? = 180
			V = 51	Nb = 94	Ta = 182
			Cr = 52	Mo = 96	W = 186
			Mn = 55	Rh = 104,4	Pt = 197,4
			Fe = 56	Ru = 104,4	Ir = 198
		Ni =	Co = 59	Pd = 106,6	Os = 199
			Cu = 63,4	Ag = 108	Hg = 200
H = 1			Zn = 65,2	Cd = 112	
	Be = 9,4	Mg = 24	? = 68	Ur = 116	Au = 197?
	B = 11	Al = 27,4	? = 70	Sn = 118	
	C = 12	Si = 28	As = 75	Sb = 122	Bi = 210?
	N = 14	P = 31	Se = 79,4	Te = 128?	
	O = 16	S = 32	Br = 80	J = 127	
	F = 19	Cl = 35,5	Rb = 85,4	Cs = 133	Tl = 204
Li = 7	Na = 23	K = 39	Sr = 87,6	Ba = 137	Pb = 207
		Ca = 40	? = 45		
		?Er = 56	Ce = 92		
		?Yt = 60	La = 94		
		?In = 75,6	Di = 95		
			Th = 118?		

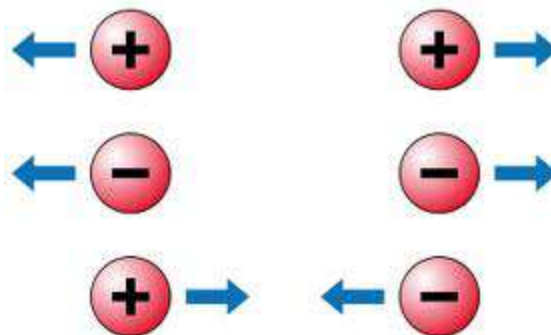
Atomic Number

- Henry Moseley studied the X-ray frequencies produced when elements were bombarded with high-energy electrons.
- Each element had a unique frequency which increased as atomic mass increased.
- From this data, Moseley assigned each element and atomic number (the number of protons).



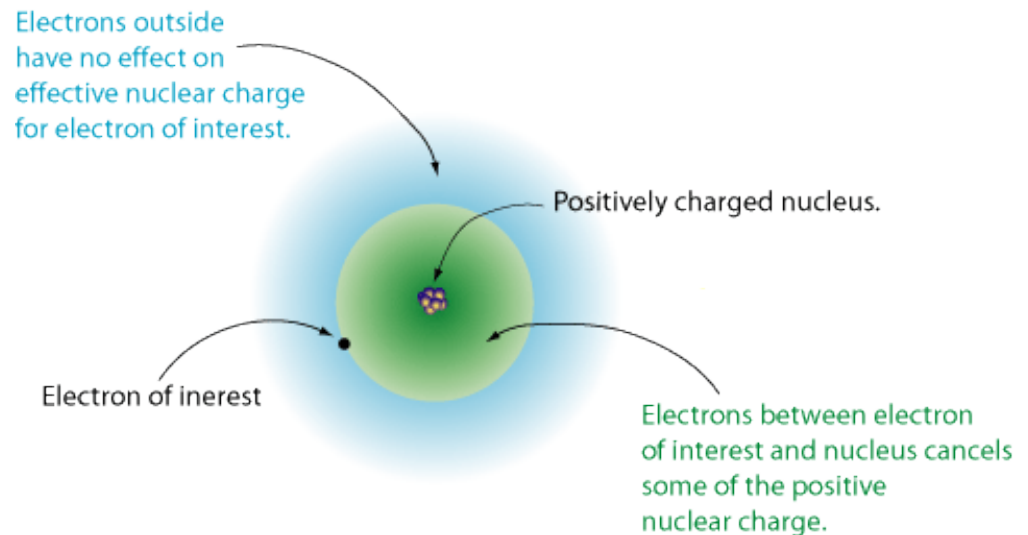
Section 7.2 – Effective Nuclear Charge

- Since electrons are negatively charged, they are attracted to nuclei, which are positively charged.
- Many of the properties of atoms depend on their electron configurations and on how strongly their outer electrons are attracted to the nucleus.



Electrons and the Nucleus

- The force of attraction between an electron and the nucleus is based on Coulomb's law and depends on two amounts:
 1. The magnitude of the net nuclear charge acting on the electron
 2. The average distance between the nucleus and the electron



Effective Nuclear Charge

- Effective nuclear charge is the actual nuclear charge minus the shielding of the core electrons, so Z_{eff} is always less than actual nuclear charge.

$$Z_{\text{eff}} = Z - S$$

Z_{eff} = effective nuclear charge

Z = actual nuclear charge (atomic number)

S = screening constant (number of core electrons)

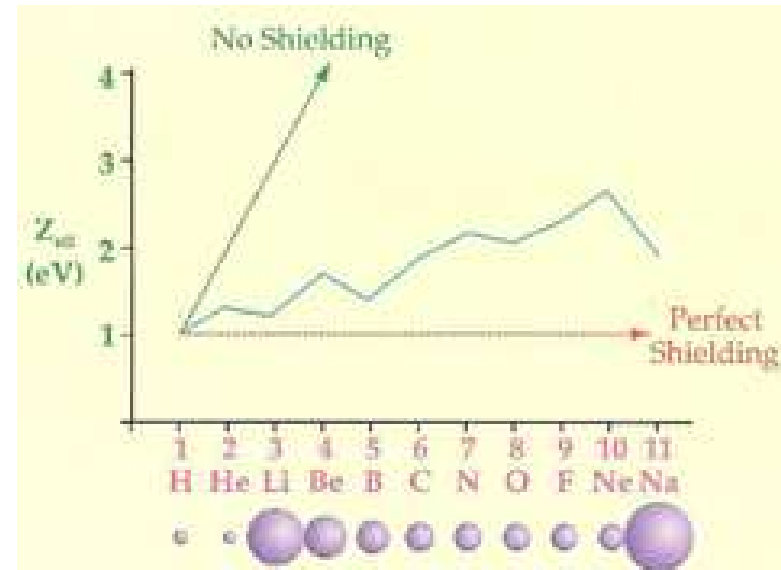
Z_{eff} Trend Across

- The effective nuclear charge increases as we move across a row (period) on the table.
- Although the number of core electrons stays the same as we move across, the actual nuclear charge increases.

$$Z_{\text{eff}} = Z - S$$

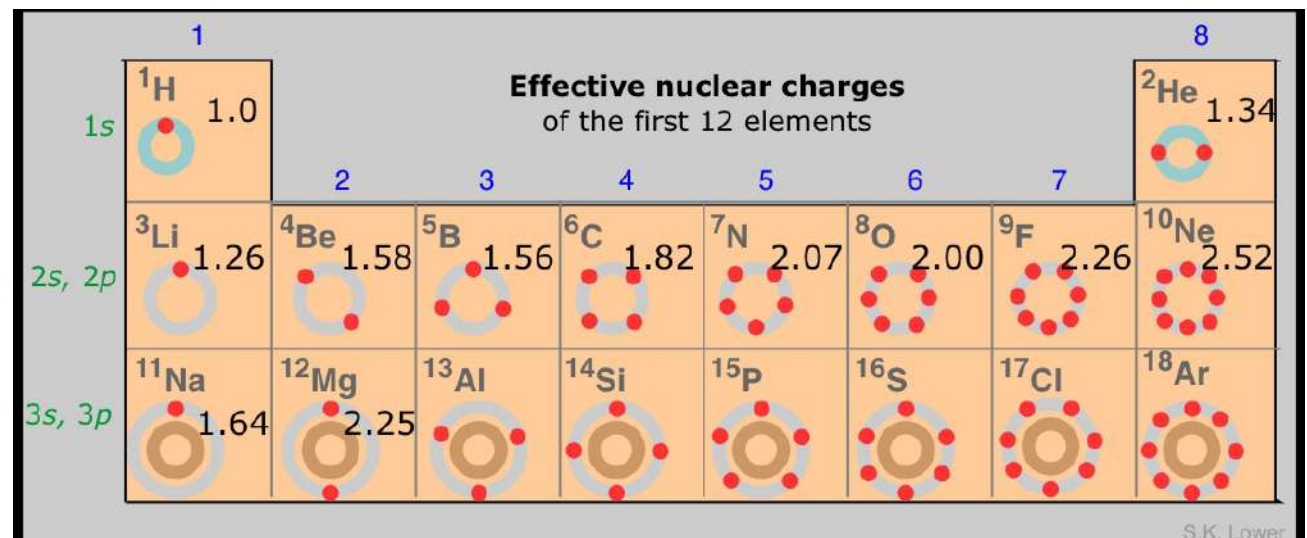
Labels for the equation:

- Z : nuclear charge
- S : average number of electrons between nucleus and electron of interest.
- Z_{eff} : effective charge seen by electron of interest.



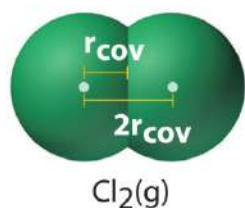
Z_{eff} Trend Down

- Going down a column, the effective nuclear charge increases slightly.
- Actual nuclear charge increases as you move down a group, but the larger electron cores are less able to screen the valence electrons.

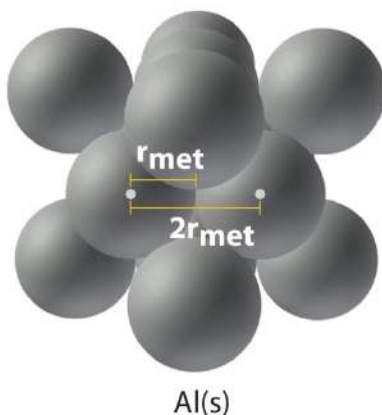


Section 7.3 – Sizes of Atoms and Ions

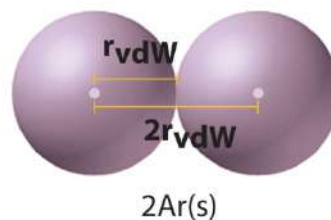
- Bonding atomic radius is measured by halving the distance between the nuclei of two bonded atoms.



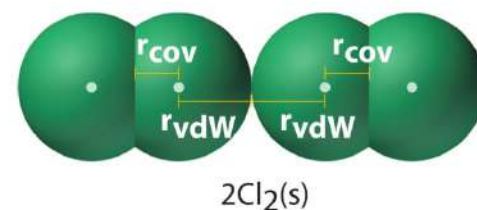
(a) Covalent radius, r_{cov}



(b) Metallic radius, r_{met}



(c) van der Waals radius, r_{vdW}



(d) Covalent vs. vdW radii

Sample Exercise 7.1

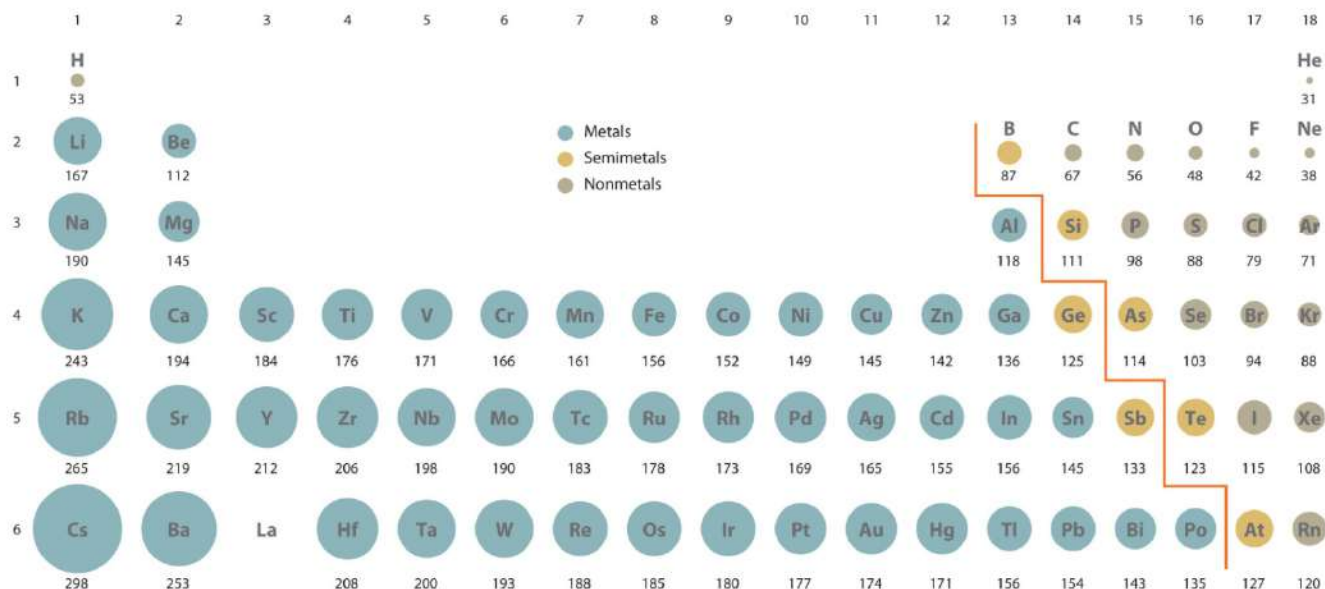
- Methyl mercaptan, CH_3SH , is used to help detect natural gas leaks. Use Figure 7.7 (p. 261) to predict the lengths of the C-S, C-H, and S-H bonds in this molecule.

Practice Exercise

- Using Figure 7.7 (p. 261), predict which will be greater, the P-Br bond length in PBr_3 or the As-Cl bond length in AsCl_3 .

Atomic Radius Trend Down

- Within a group, atomic radius increases from top to bottom.
- This trend results primarily from the increase in the size of the energy level.



Atomic Radius Trend Across

- Within each period, atomic radius tends to decrease from left to right.
- The major factor influencing this trend is the increase in Z_{eff} . The increase in Z_{eff} draws the valence electrons closer to the nucleus.

Sample Exercise 7.2

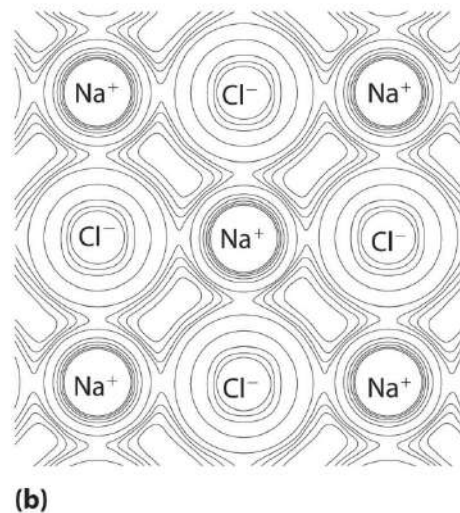
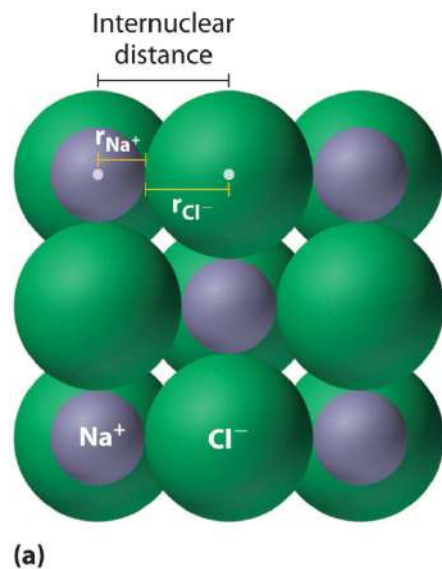
- Arrange the following atoms in order of increasing atomic size: P, S, As, and Se.

Practice Exercise

- Arrange the following atoms in order of increasing atomic radius: Na, Be, and Mg.

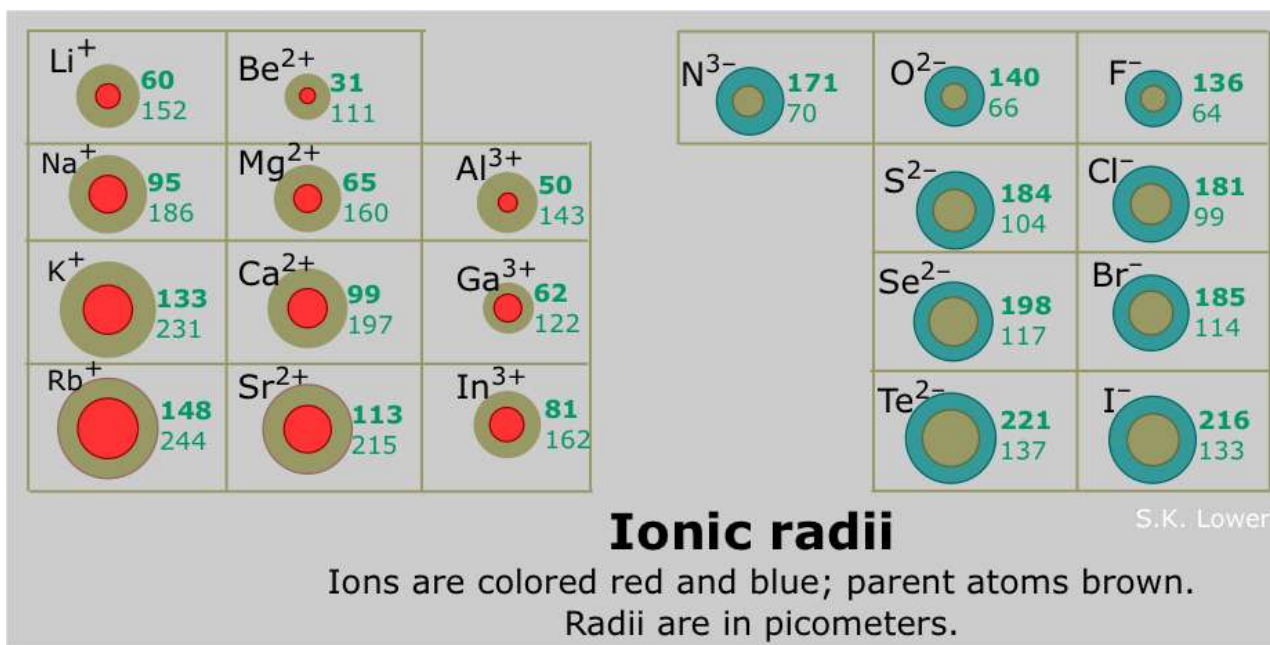
Cation Radii

- Cations are smaller than their parent atoms because electrons have been removed from the outer energy level, so the remaining electrons are pulled closer by the nucleus.



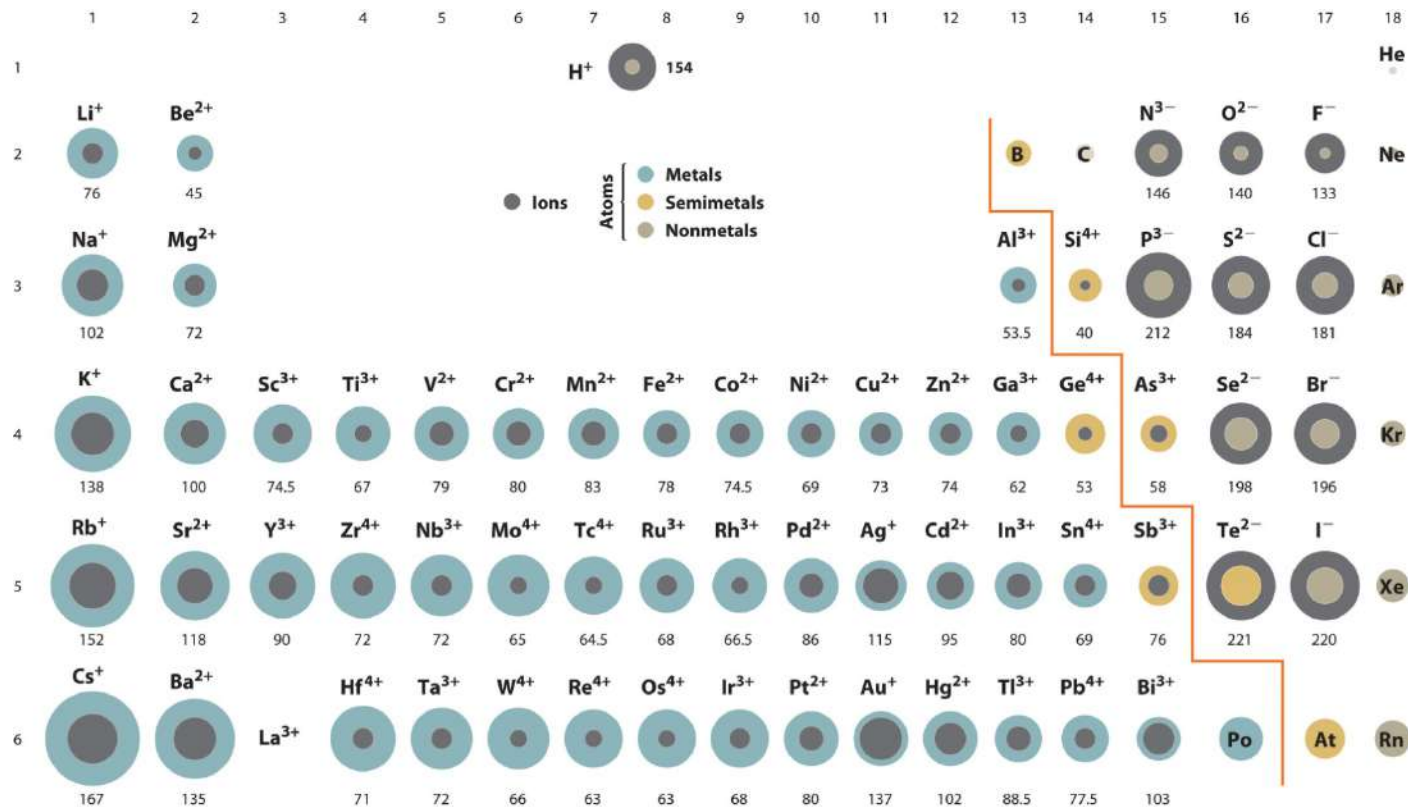
Anion Radii

- Anions are larger than their parent atoms because electrons are added which increase the electron-electron repulsion causing the electrons to spread further apart.



Ionic Radii Trend Down

- Ionic radii increases as we move down a group because the energy level increases.



Sample Exercise 7.3

- Arrange these atoms in order of decreasing size: Mg^{2+} , Ca^{2+} , and Ca .

Practice Exercise

- Which of the following atoms and ions is largest: S^{2-} , S, O^{2-} ?

Isoelectronic Series

- An isoelectronic series is a group of ions all containing the same number of electrons.
- In an isoelectronic series we can list the members in order of increasing atomic number and the radius will decrease.

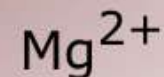
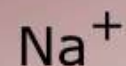
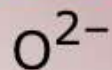
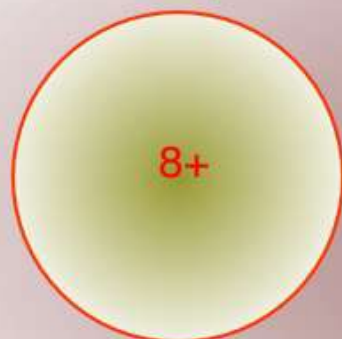
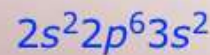
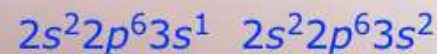
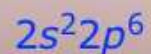
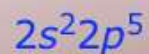
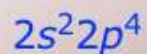
→ Increasing atomic number →



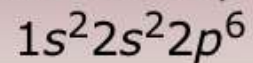
→ Decreasing atomic radius →

Isoelectronic Series

Electron configurations of the neutral atoms:



Isoelectronic series: all these species have ten electrons:



Sample Exercise 7.4

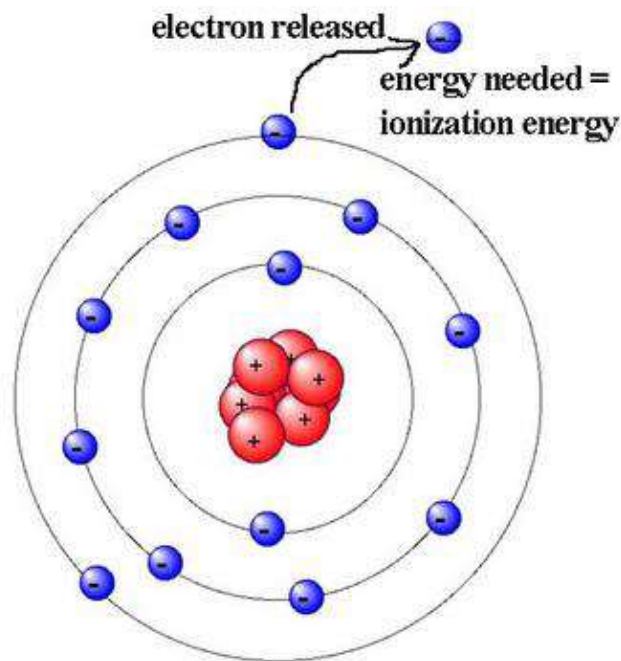
- Arrange the ions K^+ , Cl^- , Ca^{2+} , and S^{2-} in order of decreasing size.

Practice Exercise

- Which of the following ions is largest, Rb^+ , Sr^{2+} , or Y^{3+} ?

Section 7.4 – Ionization Energy

- The ionization energy of an atom or ion is the amount of energy required to remove one electron from the ground state of the isolated gaseous atom or ion.



Ionization Energies

- Notice the values for a given element increase as successive electrons are removed: $I_1 < I_2 < I_3$, and so forth.
- This trend exists because each extra electron is being removed from an increasingly positive ion.

Successive Ionization Energies for Period 3 Elements							
Element	IE ₁	IE ₂	IE ₃	IE ₄	IE ₅	IE ₆	IE ₇
Na	498	4560	6910	9540	13 400	16 600	20 100
Mg	736	1445	7730	10 600	13 600	18 000	21 700
Al	577	1815	2740	11 600	15 000	18 310	23 290
Si	787	1575	3220	4350	16 100	19 800	23 800
P	1063	1890	2905	4950	6270	21 200	25 400
S	1000	2260	3375	4565	6950	8490	27 000
Cl	1255	2295	3850	5160	6560	9360	11 000
Ar	1519	2665	3945	5770	7230	8780	12 000

Ionization Energies

- There is a sharp increase in the ionization energy that occurs when an inner-shell electron is removed.
- This is the reason that only valence electrons are involved in bonding.

Table 2.2 The Ionization Energies (kJ mol^{-1}) of the First Twenty Elements

Z	Element	First	Second	Third	Fourth	Fifth	Sixth
1	H	1,312					
2	He	2,373	5,251				
3	Li	520	7,300	11,815			
4	Be	899	1,757	14,850	21,005		
5	B	801	2,430	3,660	25,000	32,820	
6	C	1,086	2,350	4,620	6,220	38,000	47,261
7	N	1,400	2,860	4,580	7,500	9,400	53,000
8	O	1,314	3,390	5,300	7,470	11,000	13,000
9	F	1,680	3,370	6,050	8,400	11,000	15,200
10	Ne	2,080	3,950	6,120	9,370	12,200	15,000
11	Na	495.9	4,560	6,900	9,540	13,400	16,600
12	Mg	738.1	1,450	7,730	10,500	13,600	18,000
13	Al	577.9	1,820	2,750	11,600	14,800	18,400
14	Si	786.3	1,580	3,230	4,360	16,000	20,000
15	P	1,012	1,904	2,910	4,960	6,240	21,000
16	S	999.5	2,250	3,360	4,660	6,990	8,500
17	Cl	1,251	2,297	3,820	5,160	6,540	9,300
18	Ar	1,521	2,666	3,900	5,770	7,240	8,800
19	K	418.7	3,052	4,410	5,900	8,000	9,600
20	Ca	589.5	1,145	4,900	6,500	8,100	11,000

Sample Exercise 7.5

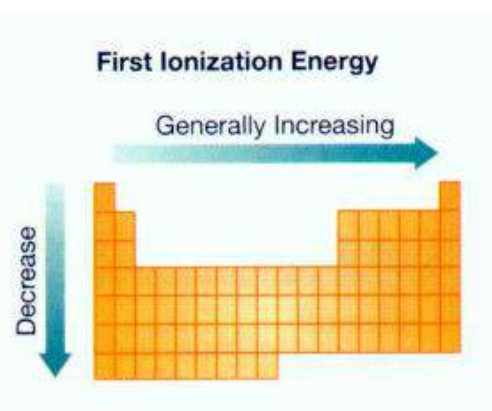
- Based on the locations of sodium, calcium, and sulfur, predict the one with the largest second ionization energy.

Practice Exercise

- Which will have the greater third ionization energy, Ca or S?

Ionization Energy Trend Across

- Ionization energy generally increases as you move across a period.
- This trend occurs because moving across the periodic table, Z_{eff} increases and the radius of the atom decreases, so more energy is required to remove an electron.



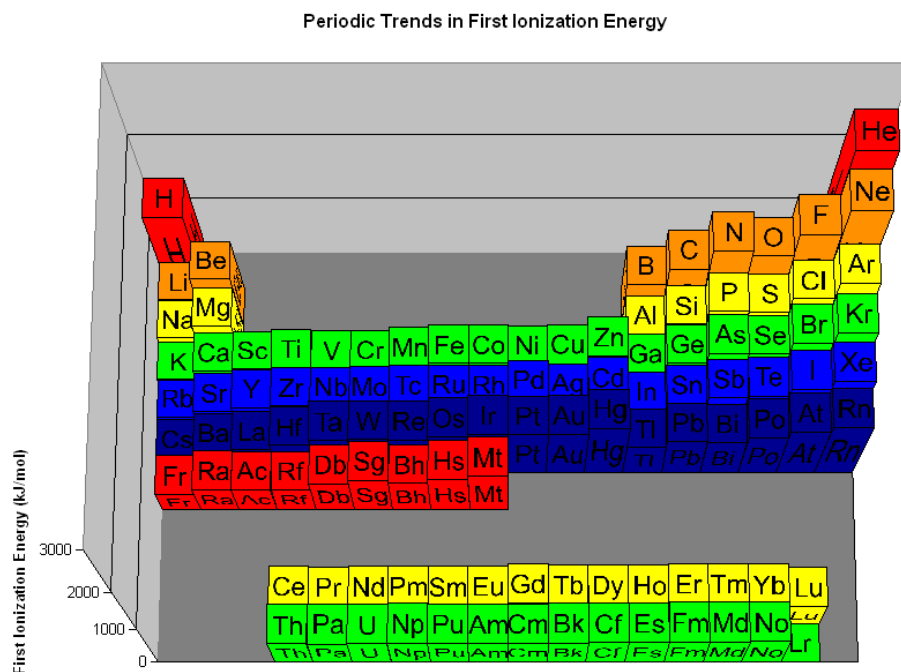
Ionization Energy Trend Down

- Ionization Energy decreases as you move down a group.
- This trend occurs because the electrons are farther from the nucleus since they are in larger energy levels, so the energy required to remove one is lower.



Ionization Energy Trend d-block

- The change in ionization energy is greater in the s and p blocks of the periodic table. The energies only increase slightly across the d and f blocks.



Sample Exercise 7.6

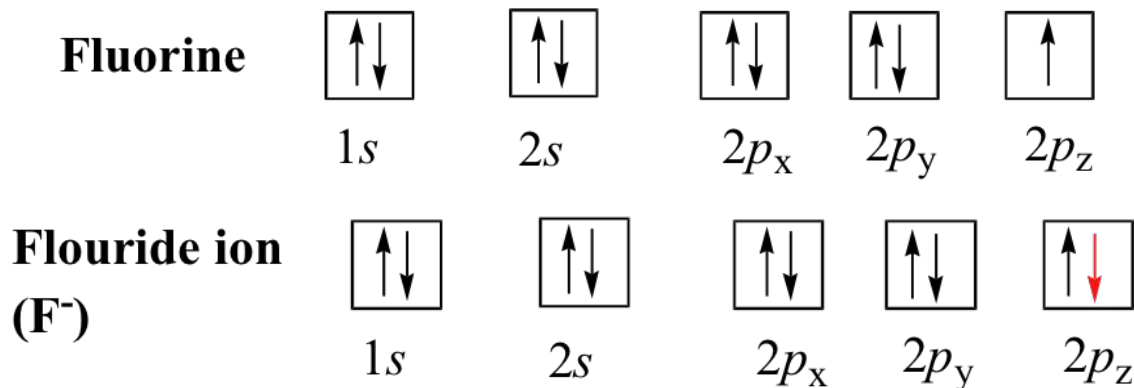
- Arrange the following atoms in order of increasing first ionization energy: Ne, Na, P, Ar, K.

Sample Exercise

- Which has the lowest first ionization energy, B, Al, C, or Si? Which has the highest ionization energy?

Electron Configuration for Ions

- When electrons are removed from a cation, they are removed from the highest sublevel in the highest principle energy level.
- When electrons are added to an anion, they are added to the last partially filled orbital or the next sublevel.



Sample Exercise 7.7

- Write the electron configuration for the following:



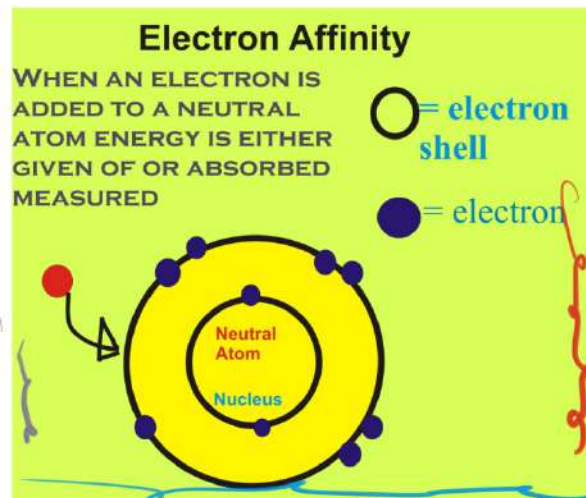
Sample Exercise

- Write the electron configuration for the following:



Section 7.5 – Electron Affinities

- The energy change that occurs when an electron is added to a gaseous atom is called the electron affinity. If measure the attraction of the atom for the added electron.
- For most atoms, energy is released when an electron is added.



Electron Affinity Trend Across

- Electron affinity does not have a consistent trend going across a period. It does overall increase as you move across.
- This trend occurs due to the increased Z_{eff} and smaller atomic radius.

H -73							He >0
Li -60	Be >0	B -27	C -122	N >0	O -141	F -328	Ne >0
Na -53	Mg >0	Al -43	Si -134	P -72	S -200	Cl -349	Ar >0
K -48	Ca -4	Ga -30	Ge -119	As -78	Se -195	Br -325	Kr >0
Rb -47	Sr -11	In -30	Sn -107	Sb -103	Te -190	I -295	Xe >0
1A	2A	3A	4A	5A	6A	7A	8A

Electron Affinity Trend Down

- The electron affinity slightly decreases as you move down a group.
- This trend is due to the larger energy levels that are farther from the nucleus.

The diagram illustrates the periodic trend of electronegativity. The horizontal axis shows increasing electronegativity from left to right across the periodic table, while the vertical axis shows decreasing electronegativity from top to bottom.

	← Increasing Or Decreasing Affinity →																High Affinity			
	IA																		VIIIA	
1	H	He																		
2	Li	Be									B	C	N	O	F	Ne				
3	Na	Mg	Al	Si	P	S	Cl	Ar												
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe		
6	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn		
7	Fr	Ra	Ac																	
																			Low Affinity	
																			↓ Becomes Less Negative	

Section 7.6 – Metals, Nonmetals, and Metalloids

Periodic Table

Periodic Table																8A	
1A																2	
1 H 1.008																2 He 4.003	
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 23.00	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
		3B	4B	5B	6B	7B	8B					1B	2B				
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0	89 Ac 227.0	104 Rf (261)	105 Ha (262)	106 Unh (263)	107 Uns (262)			109 Une (267)								

Lanthanides

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
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Actinides

90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)
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Properties of Metals

- Solids at room temperature (except Hg)
- Low ionization energies, so they form cations
- Metals are oxidized (lost electrons) in reactions
- Malleable
- Ductile
- Good conductors
- Form ionic compounds with nonmetals
- Metal oxides are basic (ex. Na_2O)



Sample Exercise 7.8

- a. Would you expect scandium oxide to be a solid, liquid, or gas at room temperature?

- b. Write the balanced equation for the reaction of scandium oxide (Sc^{3+}) with nitric acid.

Practice Exercise

- Write the balance equation for the reaction between copper (II) oxide and sulfuric acid.

Properties of Nonmetals

- Tend to be gases at room temperature
- High electron affinities, so they form anions
- Nonmetals are reduced (gain electrons) in reactions
- Brittle
- Poor conductors
- Form molecular compounds with nonmetals
- Nonmetal oxides are acidic



Sample Exercise 7.9

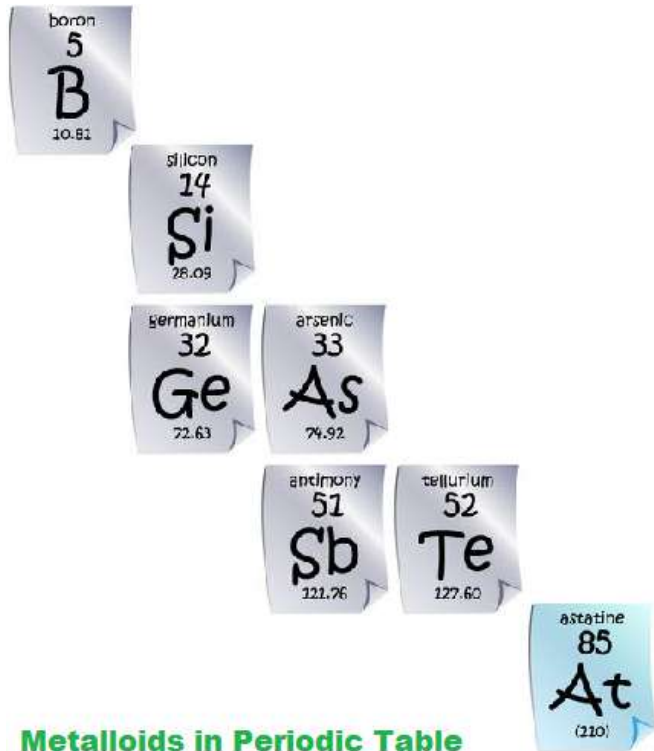
- Write the balanced equation for the reactions of solid selenium dioxide and the following:
 - a. water
 - b. aqueous sodium hydroxide

Practice Exercise

- Write the balanced equation for the reaction of solid tetraphosphorus hexoxide with water.

Metalloids

- Metalloids have properties intermediate between those of metals and nonmetals.



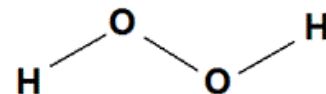
Section 7.8 – Group Trends for the Active Metals

- The alkali metals (group 1) and the alkaline earth metals (group 2) are considered the active metals.

Periodic Table of Elements																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H Hydrogen 1.00794	2 He Helium 4.002602																
3 Li Lithium 6.941	4 Be Beryllium 9.012182																
5 Na Sodium 22.98976928	6 Mg Magnesium 24.304																
7 K Potassium 39.0983	8 Ca Calcium 40.078	9 Sc Scandium 44.955912	10 Ti Titanium 47.88	11 V Vanadium 50.9415	12 Cr Chromium 51.9961	13 Mn Manganese 54.938045	14 Fe Iron 55.845	15 Co Cobalt 58.933195	16 Ni Nickel 58.6934	17 Cu Copper 63.546	18 Zn Zinc 65.38	19 Ga Gallium 69.723	20 Ge Germanium 72.64	21 As Arsenic 74.9216	22 Se Selenium 78.96	23 Br Bromine 79.904	24 Kr Krypton 83.798
19 Rb Rubidium 85.4678	20 Sr Strontium 87.62	21 Y Yttrium 88.90584	22 Zr Zirconium 91.224	23 Nb Niobium 92.90638	24 Mo Molybdenum 95.94	25 Tc Technetium 98.9062	26 Ru Ruthenium 101.07	27 Rh Rhodium 102.9055	28 Pd Palladium 106.42	29 Ag Silver 107.8682	30 Cd Cadmium 112.411	31 In Indium 114.818	32 Sn Tin 118.710	33 Sb Antimony 121.757	34 Te Tellurium 127.6	35 I Iodine 126.90547	36 Xe Xenon 131.29
37 Cs Cesium 132.90545196	38 Ba Barium 137.327	39 La Lanthanum 138.90547	40 Hf Hafnium 178.49	41 Ta Tantalum 180.94788	42 W Tungsten 183.84	43 Re Rhenium 186.207	44 Os Osmium 190.23	45 Ir Iridium 192.222	46 Pt Platinum 195.084	47 Au Gold 196.966569	48 Hg Mercury 200.59	49 Tl Thallium 204.3833	50 Pb Lead 207.2	51 Bi Bismuth 208.9804	52 Po Polonium 209	53 At Astatine 210	54 Rn Radon 222
55 Fr Francium 223	56 Ra Radium 226	57-71 Lanthanoids	72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.222	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.9804	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222
87 Fr Francium 223	88 Ra Radium 226	89-103 Actinoids	104 Db Dubnium 261	105 Db Dubnium 261	106 Sg Seaborgium 266	107 Bh Bohrium 264	108 Hs Hassium 277	109 Mt Meitnerium 268	110 Ds Darmstadtium 271	111 Rg Roentgenium 272	112 Uub Ununbium 285	113 Uut Ununtrium 284	114 Uuq Ununquadium 289	115 Uup Ununpentium 288	116 Uuh Ununhexium 292	117 Uus Ununseptium 294	118 Uuo Ununoctium 294
For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.																	
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57 La Lanthanum 138.90547	58 Ce Cerium 140.12	59 Pr Praseodymium 140.90768	60 Nd Neodymium 144.242	61 Pm Promethium 145	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92535	66 Dy Dysprosium 162.502	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.967			
89 Ac Actinium 227	90 Th Thorium 232.03806	91 Pa Protactinium 231.03688	92 U Uranium 238.02891	93 Np Neptunium 237	94 Pu Plutonium 244	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 247	98 Cf Californium 251	99 Es Einsteinium 252	100 Fm Fermium 257	101 Md Mendelevium 258	102 No Nobelium 259	103 Lr Lawrencium 262			

Properties of Alkali Metals

- Soft metallic solids with low melting points
- When bonded with hydrogen, the hydrogen has a -1 charge (hydride). Ex: LiH
- React vigorously with water
- When bonded with oxygen, they can form the following:
 - a. Oxide (O^{2-}) = Li_2O
 - b. Peroxide (O_2^{2-}) = Na_2O_2
 - c. Superoxide (O_2^-) = KO_2



HYDROGEN PEROXIDE

Sample Exercise 7.10

- Write a balanced equation that predicts the reaction of cesium metal with the following:
 - a. Cl_2
 - b. H_2O
 - c. H_2

Practice Exercise

- Write a balanced equation for the reaction between potassium metal and sulfur.

Properties of Alkaline Earth Metals

- Harder and more dense than alkali metals
- Higher melting point than alkali metals
- Less reactive with water than alkali metals



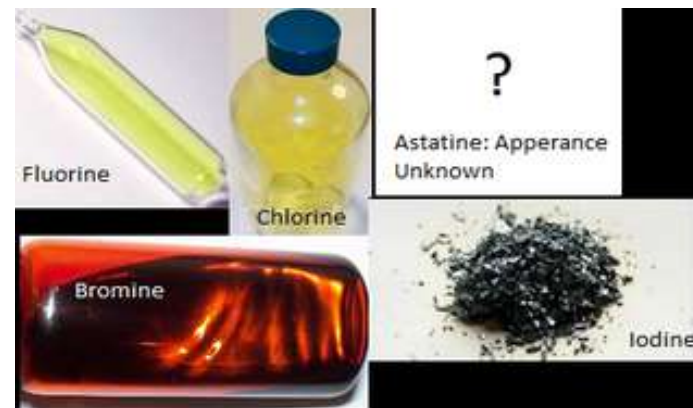
alkali metalalkaline earth metal

Section 7.8 – Group Trends for Selected Nonmetals

- Hydrogen is in the alkali metal group even though it is a nonmetal. It can be metallic under extremely high pressures.
- It belongs in group 1 because it has 1 valence electron and can form a +1 charge.
- It belongs in group 17 because it is a nonmetal, it can form a -1 charge, and it only needs 1 more electron to achieve noble gas configuration.

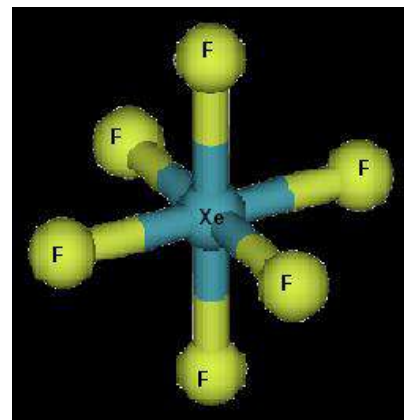
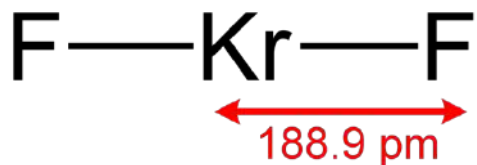
Group 17 - Halogens

- Fluorine is a pale yellow gas.
- Chlorine is a greenish-yellow gas.
- Bromine is a reddish-brown liquid.
- Iodine is a gray/black solid that forms purple vapors.
- Halogens are very reactive.



Group 18 – Noble Gases

- Noble gases have full outer energy levels, so they are very unreactive.
- They rarely form compounds, but compounds have been formed with xenon, krypton, and argon. Most of these compounds contain fluorine, since it is highly reactive.



Sample Integrative Exercise

- a. Bismuth subsalicylate is the active ingredient in Pepto-Bismol. The covalent atomic radii of thallium and lead are 1.48 angstrom and 1.47 angstrom. Using these values, predict the radius of the element bismuth.

Sample Integrative Exercise

- b. What accounts for the general increase in atomic radius going down group 15?

Sample Integrative Exercise

- c. Bismuth is used in low-melting alloys. The element itself is a brittle white crystalline solid. How do these characteristics fit with the fact that bismuth is in the same periodic group with such nonmetallic elements like nitrogen and phosphorus?

Sample Integrative Exercise

- d. Bi_2O_3 is a basic oxide. Write a balanced equation for its reaction with dilute nitric acid. If 6.77g of Bi_2O_3 is dissolved in dilute acidic solution to make 0.500L of solution, what is the molarity of the solution of Bi^{3+} ion?

Sample Integrative Exercise

- e. ^{209}Bi is the heaviest stable isotope of any element. How many protons and neutrons are present in the nucleus?

Sample Integrative Exercise

- f. The density of Bi at 25°C is 9.808 g/cm³. How many Bi atoms are present in a cube of the element that is 5.00cm on each edge? How many moles of the element are present?