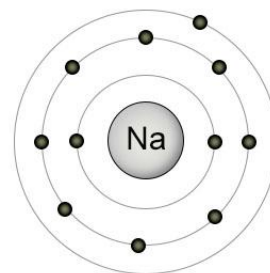

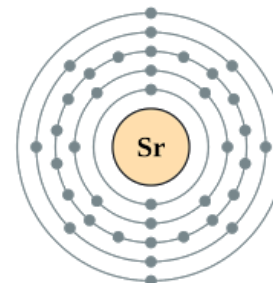


PERIODIC TRENDS involving SIZE & ENERGY LEVELS of ATOMS

- Measured in picometres (pm)
- Distance from nucleus to valence shell



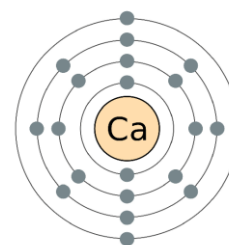
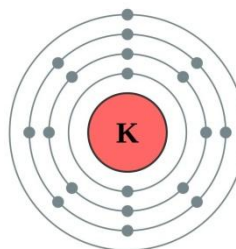
- (a) as you go down a family, the radius increases
- Valence shell farther from nucleus
 - Valence electrons attracted less by nucleus
 - Inner electrons "shield" the valence electrons from nuclear attraction.
- 



Which atom is larger -- Br or Cl?

- (b) as you go from left to right along a period, the radius decreases
- Nucleus gets stronger (more positive)
 - Valence electrons pulled closer by stronger attraction

Which atom is larger -- K or Ca?



Which atom is larger -- S or Al?

Order the atoms according to size: Na P Rb

INCREASING ATOMIC RADIUS

INCREASING ATOMIC RADIUS

1																	2
H																	He
1.00794																	4.0026
3	4															5	6
Li	Be															B	C
6.941	9.012182															10.81	12.01
11	12															13.44	14.01
Na	Mg															28.09	28.09
22.99071	24.305															70.92	72.04
19	20	21	22	23	24	25	26	27	28	29	30						
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn						
39.0983	40.078		47.88	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.38						
87.62	88.07		88.91	91.22	92.91	95.94	97.06	101.07	102.91	106.42	107.75						
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
85.468	87.62		91.22	92.91	95.94		101.07	102.91	106.42	107.75	112.41	114.82	117.48	121.76	127.60	131.29	131.29
132.91	137.33		138.91	140.91	144.91		146.07	150.92	151.92	157.25	158.91	162.57	167.30	172.04	176.04	180.90	186.91
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
132.91	137.33		140.91	144.91	146.07	150.92	151.92	157.25	158.91	162.57	167.30	172.04	176.04	180.90	186.91	192.22	198.91
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
132.91	137.33		140.91	144.91	146.07	150.92	151.92	157.25	158.91	162.57	167.30	172.04	176.04	180.90	186.91	192.22	198.91
88	89	104	105	106	107	108	109	110	111	112							
Ra	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf							
226.025	227.033		231.036	232.037	237.043	244.063	247.065	251.077	257.103	261.105							
Fr	Ra	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf						
223.019	226.025		231.036	232.037	237.043	244.063	247.065	251.077	257.103	261.105	267.123						

② IONIZATION ENERGY

- Measured in kJ/mol
- Atom is neutral – the number of protons = the number of electrons
- Atom gains or loses electrons → forms an ion (charged particle)
- Ion gains electrons → negative charge (anion)
- Ion loses electrons → positive charge (cation)

IE = energy needed to remove an electron from the valence shell

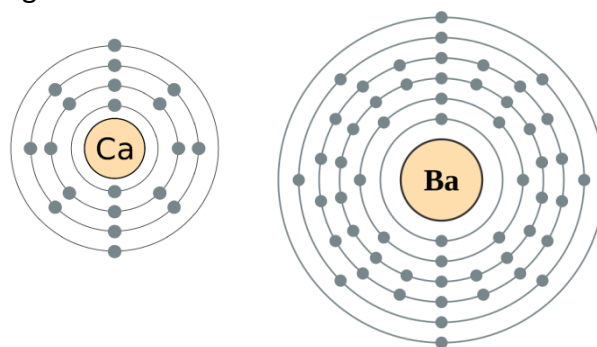
- Easier to remove from metals than non-metals (less energy, lower IE)
 - Farther valence shell is from nucleus, the lower the IE.
- (a) as you go down a family, the radius increases; therefore, the IE decreases
- Valence electrons attracted less to nucleus
- (b) from left to right along a period, radius decreases; therefore, the IE increases
- Valence electrons attracted stronger to nucleus

In each group of atoms, which one has the larger IE?

1. Ca or Ba

2. O or C

3. Na or K or Cl



INCREASING IONIZATION ENERGY

1 H Hydrogen 1.00794																	2 He Helium 4.003														
3 Li Lithium 6.941	4 Be Beryllium 9.012182															5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00643	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797										
11 Na Sodium 22.989769	12 Mg Magnesium 24.3050															13 Al Aluminum 26.981538	14 Si Silicon 28.0855	15 P Phosphorus 30.973761	16 S Sulfur 32.066	17 Cl Chlorine 35.4527	18 Ar Argon 39.948										
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955910	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938049	26 Fe Iron 55.845	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80														
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.29														
55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 La Lanthanum 138.9055	58 Ce Cerium 140.12	59 Pr Praseodymium 140.90768	60 Nd Neodymium 144.24	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 162.50019	67 Ho Holmium 164.93033	68 Er Erbium 167.259	69 Tm Thulium 168.93032	70 Yb Ytterbium 173.05468	71 Lu Lutetium 174.967	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 195.078	79 Au Gold 196.96655	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98039	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (264)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 Ds Darmstadtium (269)	111 Rg Roentgenium (272)	112 Cn Copernicium (277)																				

INCREASING IONIZATION ENERGY

INCREASING IONIZATION ENERGY

③ ELECTRON AFFINITY

- Measured in kJ/mol

EA = change in energy when an electron added to valence shell to make an anion.

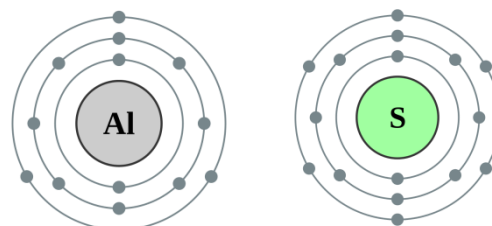
- Metals prefer to lose electrons, not gain; therefore, low electron affinity
- Non-metals prefer to gain electrons; therefore, higher EA
- Energy is released when electrons are gained
- Trend is more irregular than atomic radius and ionization energy, but resemble IE and opposite to atomic radius.

In each group of atoms, which one has the larger EA?

1. Al or S

2. Cs or K

3. Cl or Ca or Mg



INCREASING ELECTRON AFFINITY

1 H Hydrogen 1.00794																	2 He Helium 4.003				
3 Li Lithium 6.941	4 Be Beryllium 9.012182															5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00643	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
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87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 (110)	111 (111)	112 (112)	113 (113)	114 (114)								

INCREASING ELECTRON AFFINITY

INCREASING ELECTRON AFFINITY

