



DLO

- Be able to describe periodic trends

Bell ?

- Why do ions form?

Periodic Trends



**Charge of Ions, Ionization Energy
Electronegativity, Atomic Radius**

Periodic Trends



- The periodic table is not arranged randomly
- Mendeleev was able to organize the periodic table in such a way that the properties of missing elements could be predicted.
- This arrangement we now know follows trends that are based on the number and arrangement of electrons in an atom.

Electron Configuration



- Electron configurations tell you the energy level and sub shells where electrons can be found.
- As you write the electron configuration you notice a pattern
- Write the electron configuration for the following:
 - Sodium- $1s^2 2s^2 2p^6 3s^1$
 - Aluminum- $1s^2 2s^2 2p^6 3s^2 3p^1$
 - Iron- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$
 - Bromine- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

Valence Electrons



- Those electrons in the highest energy level or the outer most shell are called valence electrons
- These electrons are the ones that atoms lose, gain, or share to form bonds.
- These electrons also determine the stability of the atom.
- The closer the atom is to having a full outer shell of 8 the more stable it becomes. This is called the Octet rule.

Charge of Ions



- Elements as they appear on the periodic table are neutral in charge
 - Why? Because the number of protons and electrons are equal
- When an atoms gains or loses electrons what happens? A charged atom, called an ion, is formed.
- Looking at the electron configuration for the elements a pattern appears with the s and p orbitals
 - What is the trend across a period? group?
 - What does this mean for the total number of electrons for the outer most shell?

Electron Configuration Short hand



- Who likes having to write those long electron configurations?
- Now you can learn the shortcut, using Noble Gases
- What is special about the Noble Gases?
- They have a full outer shell of electrons.
- They're all in the p block, so they have a full outer p shell

Steps for Shorthand Electron configuration



1. Determine the closest noble gas that comes before the element you need (the atomic number is less for the noble gas)
2. Write the symbol for the noble gas and put brackets around it
3. Remaining electrons put into electron configuration

Shorthand Example



- Shorthand for Calcium:
 1. Nearest Noble Gas before Calcium? Argon
 2. Symbol for that Noble Gas? Put it in brackets [Ar]
 3. Remaining Electrons? 2
- Calcium: [Ar] 4s²
- Calcium full configuration:
 - 1s² 2s²2p⁶ 3s² 3p⁶4s²

Atomic Radius



- Atomic radius is the measure of half the distance of two like atoms bonded together

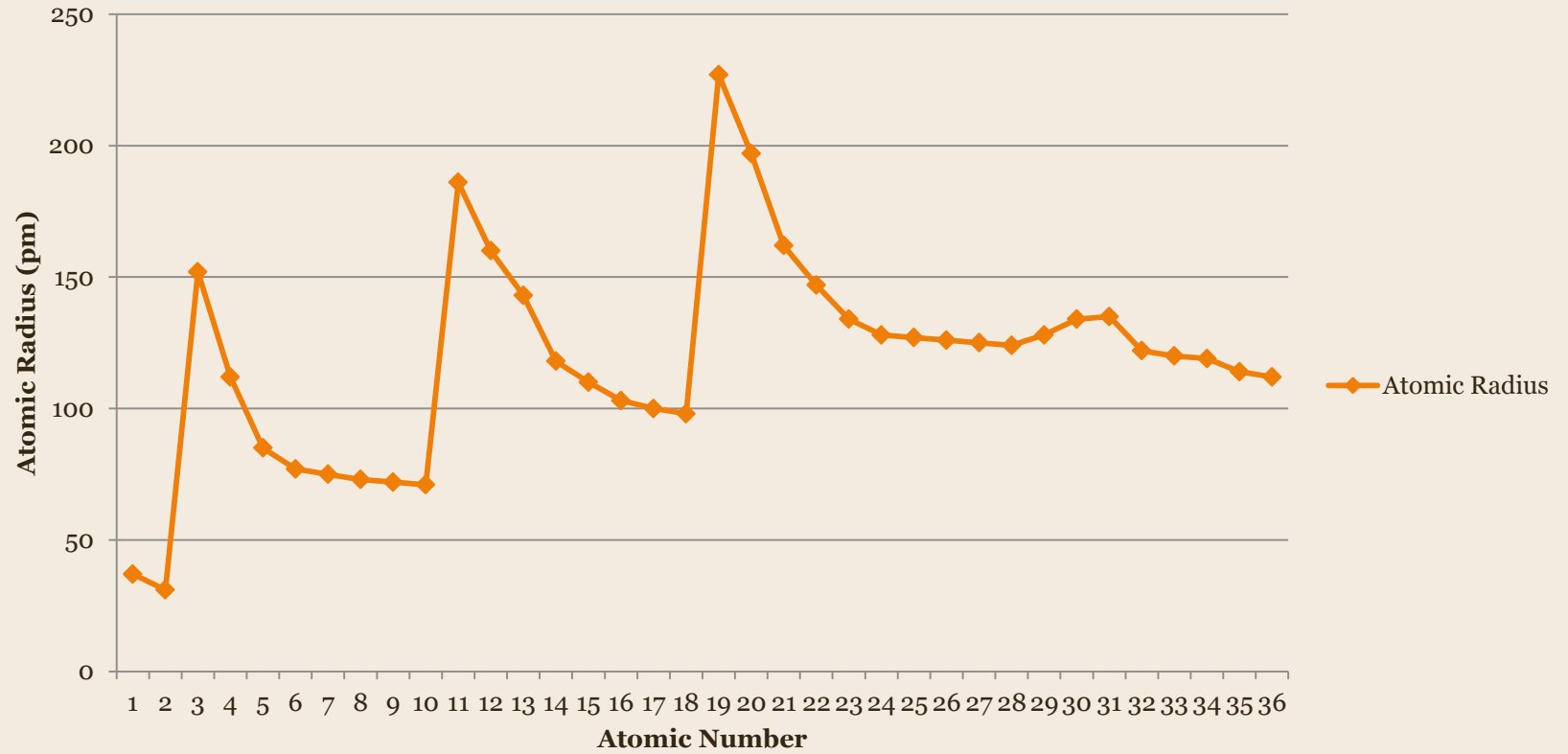
- What is the trend: across a period? across a group?
- Why is this occurring?



INCREASING ATOMIC RADIUS

INCREASING ATOMIC RADIUS																															
1 H Hydrogen 1.00794																	2 He Helium 4.003														
3 Li Lithium 6.941	4 Be Beryllium 9.012182															10 Ne Neon 20.1797															
11 Na Sodium 22.98976928	12 Mg Magnesium 24.304															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 54.938044	26 Fe Iron 55.845	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.39	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 106.42	46 Pd Palladium 107.8682	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 138.90547	58 Ce Cerium 140.12	59 Pr Praseodymium 140.90764	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 158.92534	66 Dy Dysprosium 162.50033	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93032	70 Yb Ytterbium 173.05446	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 196.96657	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98038	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon 222
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	90 Th Thorium (232)	91 Pa Protactinium (231)	92 U Uranium (238)	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)																

Atomic Radius



Ionization Energy



- Ionization energy is the energy required to remove the outer most electrons
 - Why would atoms want other another atom's electrons?
 - What is the trend across a period? group?
- The octet rule plays a part in determining the ionization energy
 - What does Octet mean?

INCREASING IONIZATION ENERGY

1 H <small>Hydrogen 1.00784</small>																	2 He <small>Helium 4.0026</small>																	
3 Li <small>Lithium 5.2091</small>	4 Be <small>Beryllium 9.0023712</small>															5 B <small>Boron 8.01131</small>	6 C <small>Carbon 12.2107</small>	7 N <small>Nitrogen 14.02044</small>	8 O <small>Oxygen 15.9994</small>	9 F <small>Fluorine 18.9984032</small>	10 Ne <small>Neon 20.81107</small>													
11 Na <small>Sodium 22.989770</small>	12 Mg <small>Magnesium 24.3040</small>															13 Al <small>Aluminum 26.981538</small>	14 Si <small>Silicon 28.0855</small>	15 P <small>Phosphorus 30.973761</small>	16 S <small>Sulfur 32.066</small>	17 Cl <small>Chlorine 35.4527</small>	18 Ar <small>Argon 39.948</small>													
19 K <small>Potassium 50.9988</small>	20 Ca <small>Calcium 40.078</small>	21 Sc <small>Scandium 44.955910</small>	22 Ti <small>Titanium 47.867</small>	23 V <small>Vanadium 50.9415</small>	24 Cr <small>Chromium 51.9961</small>	25 Mn <small>Manganese 54.938045</small>	26 Fe <small>Iron 55.845</small>	27 Co <small>Cobalt 58.933200</small>	28 Ni <small>Nickel 58.6934</small>	29 Cu <small>Copper 63.546</small>	30 Zn <small>Zinc 65.39</small>	31 Ga <small>Gallium 69.723</small>	32 Ge <small>Germanium 72.61</small>	33 As <small>Arsenic 74.9216</small>	34 Se <small>Selenium 78.96</small>	35 Br <small>Bromine 79.904</small>	36 Kr <small>Krypton 83.80</small>																	
37 Rb <small>Rubidium 85.4678</small>	38 Sr <small>Strontium 87.62</small>	39 Y <small>Yttrium 88.90585</small>	40 Zr <small>Zirconium 91.224</small>	41 Nb <small>Niobium 92.90638</small>	42 Mo <small>Molybdenum 95.94</small>	43 Tc <small>Technetium 98.906250</small>	44 Ru <small>Ruthenium 101.07</small>	45 Rh <small>Rhodium 102.90550</small>	46 Pd <small>Palladium 106.42</small>	47 Ag <small>Silver 107.8682</small>	48 Cd <small>Cadmium 112.411</small>	49 In <small>Indium 114.818</small>	50 Sn <small>Tin 118.710</small>	51 Sb <small>Antimony 121.750</small>	52 Te <small>Tellurium 127.60</small>	53 I <small>Iodine 126.90545</small>	54 Xe <small>Xenon 131.29</small>																	
55 Cs <small>Cesium 132.90545</small>	56 Ba <small>Barium 137.327</small>	57 La <small>Lanthanum 138.9055</small>	58 Ce <small>Cerium 137.924</small>	59 Pr <small>Praseodymium 137.924</small>	60 Nd <small>Niodymium 140.9126</small>	61 Pm <small>Promethium 144.9126</small>	62 Sm <small>Samarium 150.36</small>	63 Eu <small>Europium 151.964</small>	64 Gd <small>Gadolinium 157.25</small>	65 Tb <small>Terbium 158.92534</small>	66 Dy <small>Dysprosium 162.50031</small>	67 Ho <small>Holmium 164.93032</small>	68 Er <small>Erbium 167.259</small>	69 Tm <small>Thulium 168.93032</small>	70 Yb <small>Ytterbium 173.054</small>	71 Lu <small>Lutetium 174.967</small>	72 Hf <small>Hafnium 178.49</small>	73 Ta <small>Tantalum 180.9479</small>	74 W <small>Tungsten 183.84</small>	75 Re <small>Rhenium 186.207</small>	76 Os <small>Osmium 190.23</small>	77 Ir <small>Iridium 192.222</small>	78 Pt <small>Platinum 195.078</small>	79 Au <small>Gold 196.96655</small>	80 Hg <small>Mercury 200.59</small>	81 Tl <small>Thallium 204.3833</small>	82 Pb <small>Lead 207.2</small>	83 Bi <small>Bismuth 208.98038</small>	84 Po <small>Polonium 209</small>	85 At <small>Astatine 210</small>	86 Rn <small>Radon 222</small>			
87 Fr <small>Francium 223</small>	88 Ra <small>Radium 226</small>	89 Ac <small>Actinium 227</small>	104 Rf <small>Rutherfordium 261</small>	105 Db <small>Dubnium 262</small>	106 Sg <small>Seaborgium 263</small>	107 Bh <small>Berkelium 264</small>	108 Hs <small>Hassium 265</small>	109 Mt <small>Moscovium 266</small>	110	111	112	113	114																					

INCREASING IONIZATION ENERGY

Electron Affinity



- What does affinity mean?
- Ability to attract electrons

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Electronegativity

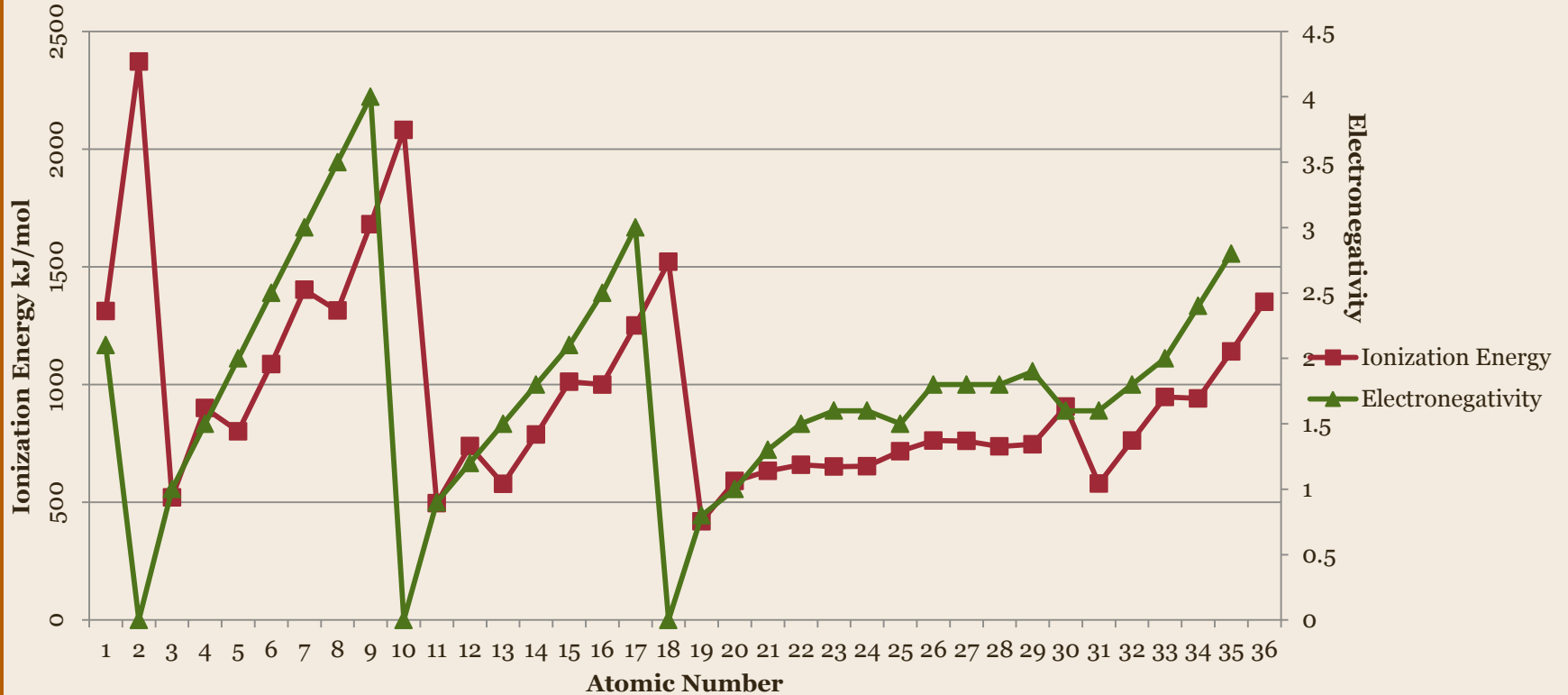


- Electronegativity is the desire for atoms to grab electrons
 - What is the trend across a period? group?
- This again is related to the Octet rule and the goal of filling the outer most energy level with electrons to have a complete outer shell.

INCREASING ELECTRONEGATIVITY

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↑ INCREASING ELECTRONEGATIVITY																					

Ionization Energy and Electronegativity as a function of Atomic Number



Exceptions



- Are there any exceptions to the trends?
- Why do you think this occurs?
- How do the exceptions relate to the s and p orbitals?