

# Ionization Energy

-- The energy required to remove an electron from an atom.

*Which elements would require a **LOT** of energy to remove an electron? Explain.*

- anions (non-metals)
- smaller atomic radius (feels more pull from  $p^+$ )
- noble gases b/c they have a full octet

*Which elements would require **LITTLE** energy to remove an electron? Explain.*

- larger atomic radius (less pull from  $p^+$ )
- alkali metals (group #1) → want to remove  $e^-$
- cation (metals)

# Ionization Energy

-- High ionization energy means that the element does not want to remove an electron --- form an anion. *nonmetal*

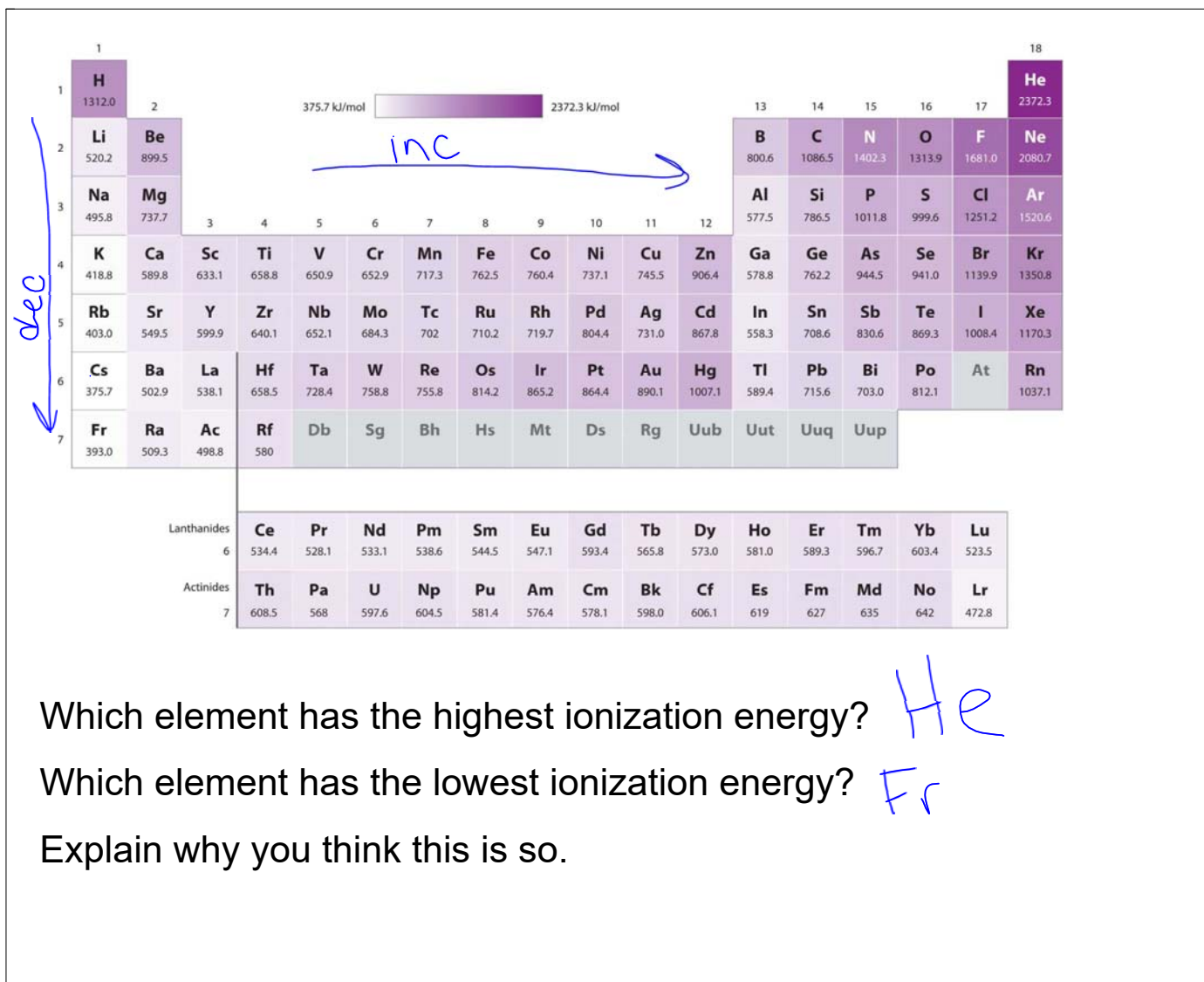


*negative ion*

-- Low ionization energy means that the element wants to remove an electron --- will form a cation *metals*



*positive ions*



Which element has the highest ionization energy?

*He*

Which element has the lowest ionization energy?

*Fr*

Explain why you think this is so.

# Ionization Energy

INCREASING IONIZATION ENERGY

b/c protons being added nonmetals don't want to lose e<sup>-</sup>

Decreasing

1 <b>H</b> Hydrogen 1.00794																	2 <b>He</b> Helium 4.003						
3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.012182																	5 <b>B</b> Boron 10.811	6 <b>C</b> Carbon 12.0107	7 <b>N</b> Nitrogen 14.00674	8 <b>O</b> Oxygen 15.9994	9 <b>F</b> Fluorine 18.9984032	10 <b>Ne</b> Neon 20.1797
11 <b>Na</b> Sodium 22.989770	12 <b>Mg</b> Magnesium 24.3050																	13 <b>Al</b> Aluminum 26.981538	14 <b>Si</b> Silicon 28.0855	15 <b>P</b> Phosphorus 30.973761	16 <b>S</b> Sulfur 32.066	17 <b>Cl</b> Chlorine 35.4527	18 <b>Ar</b> Argon 39.948
19 <b>K</b> Potassium 39.0983	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.955910	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.9415	24 <b>Cr</b> Chromium 51.9961	25 <b>Mn</b> Manganese 54.938049	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933200	28 <b>Ni</b> Nickel 58.6934	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.39	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.61	33 <b>As</b> Arsenic 74.92160	34 <b>Se</b> Selenium 78.96	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.80						
37 <b>Rb</b> Rubidium 85.4678	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.90585	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.90638	42 <b>Mo</b> Molybdenum 95.94	43 <b>Tc</b> Technetium (98)	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.90550	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.8682	48 <b>Cd</b> Cadmium 112.411	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.710	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.90447	54 <b>Xe</b> Xenon 131.29						
55 <b>Cs</b> Cesium 132.90545	56 <b>Ba</b> Barium 137.327	57 <b>La</b> Lanthanum 138.9055	58 <b>Hf</b> Hafnium 178.49	59 <b>Ta</b> Tantalum 180.9479	60 <b>W</b> Tungsten 183.84	61 <b>Re</b> Rhenium 186.207	62 <b>Os</b> Osmium 190.23	63 <b>Ir</b> Iridium 192.217	64 <b>Pt</b> Platinum 195.078	65 <b>Au</b> Gold 196.96655	66 <b>Hg</b> Mercury 200.59	67 <b>Tl</b> Thallium 204.3833	68 <b>Pb</b> Lead 207.2	69 <b>Bi</b> Bismuth 208.98038	70 <b>Po</b> Polonium (209)	71 <b>At</b> Astatine (210)	72 <b>Rn</b> Radon (222)						
87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	89 <b>Ac</b> Actinium (227)	104 <b>Rf</b> Rutherfordium (261)	105 <b>Db</b> Dubnium (262)	106 <b>Sg</b> Seaborgium (263)	107 <b>Bh</b> Bohrium (262)	108 <b>Hs</b> Hassium (265)	109 <b>Mt</b> Meitnerium (266)	110 <b>Ds</b> Darmstadtium (269)	111 <b>Rg</b> Roentgenium (272)	112 <b>Cn</b> Copernicium (277)												

↳ energy levels creates e<sup>-</sup> shielding

# Practice:

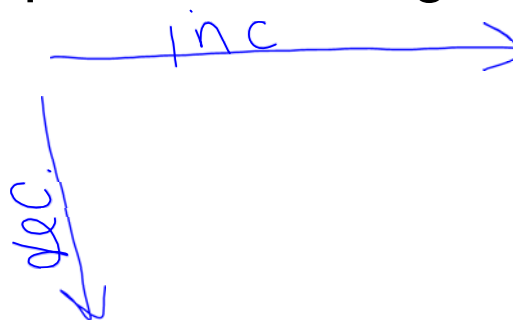
Which element in each pair has the higher ionization energy?

1. Mg or **S**

2. **N** or As

3. Cl or **Ar**

4. **Si** or Ge



# Electronegativity

-- The ability of an element to attract electrons.

*Which elements would really like additional electrons?*

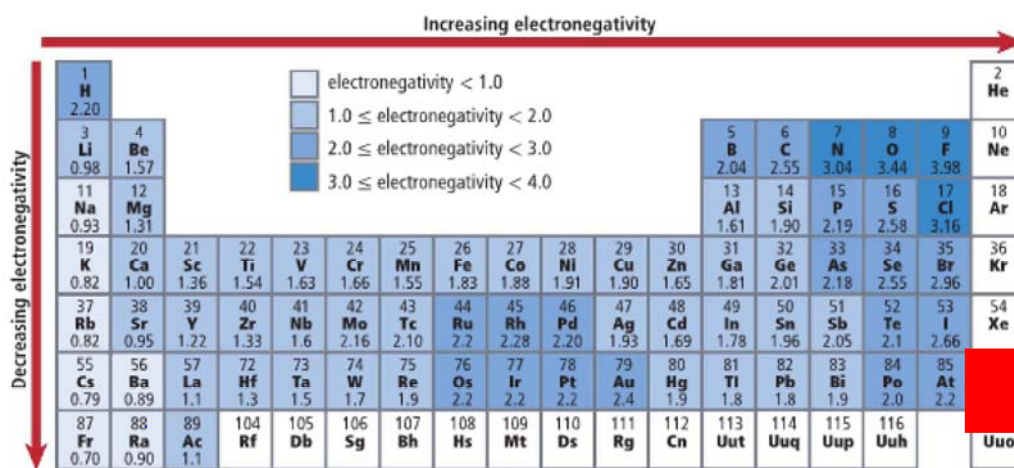
*Why?*

- elements that form anions (groups 15-17)
- halogens (nonmetals)

*Which elements would not like to have additional electrons? Why?*

- noble gases (have an octet)
- groups 1-13 → form cations (metals)

# Electronegativity



Electronegativity Values in Paulings

Which element is the most electronegative? Why?

*F because it wants to gain 1 n e- gain*

Which element is the least electronegative? Why?

*Fr loses e not gain*

Why do the noble gases not have electronegativity values?

*already have an octet*

# Practice:

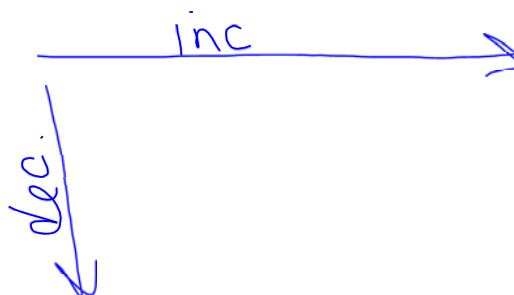
Which element in each pair has the higher electronegativity?

1. Mg or O

2. N or As

3. Cl or ~~Ne~~

4. Si or Sn





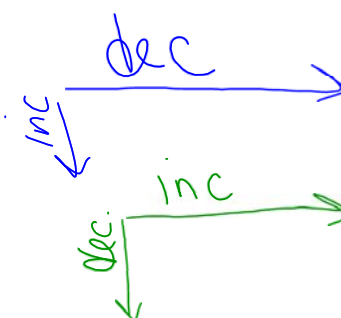
### Check for Understanding:

1. P or Cl, which has the higher:

a. atomic radius P

b. ionization energy Cl

c. electronegativity Cl

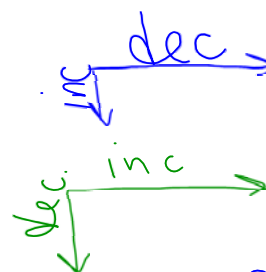


2. Ca or Ba, which has the lower:

a. atomic radius Ca

b. ionization energy Ba

c. electronegativity Ba



3. N<sup>3-</sup> or F<sup>-</sup> which has the larger ionic radius? N<sup>3-</sup>

